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POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN. PROCEEDINGS OF CONFERENCE HELD AT CHICAGO, ILLINOIS ON JANUARY 31, FEBRUARY 1-2, FEBRUARY 5-7, 1968. EXECUTIVE SESSION, MARCH 7-8 AND 12, 1968. VOLUME VI

Federal Water Pollution Control Administration
Washington, D.C.

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Executive Session
March 7, 8 and 12, 1968

CONFERENCE

Pollution of Lake Michigan and its tributary basin

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U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

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WEDNESDAY, FEBRUARY 7, 1968

MORNING SESSION

9:30 a.m.

MR. STEIN: May we reconvene?

Here is what we are going to try to do. We're going to have the Wisconsin presentation and then give the Conferees an opportunity to discuss the Federal Conclusions and Recommendations which we postponed. We are going to push right through, because we want to see what our time is without a break, and hopefully we can finish this phase of the Conference without a luncheon break.

With that I will call on Wisconsin, Mr. Holmer.

WISCONSIN PRESENTATION (CONTINUED)

MR. HOLMER: Mr. Stein, Conferees, I am going to ask Ted Wisniewski as the initial part of our preparation to read into the record or present for the record certain statements of organizations whose representatives were unable to be here this morning.

Mr. Wisniewski.

WISCONSIN WILDLIFE FEDERATION

MR. WISNIEWSKI: Mr. Chairman, Conferees, Ladies and Gentlemen.

There are several communications which the submitters have asked to be read into the record.

First is a statement on behalf of the Wisconsin Wildlife Federation.

STATEMENT ON BEHALF OF THE WISCONSIN WILDLIFE FEDERATION

The Wisconsin Wildlife Federation, as all conservationists are, is greatly concerned over the rapidly deteriorating quality of the waters in the Great Lakes Basin. We recognize the need for careful protection by high standards of interstate water quality criteria. We have repeatedly expressed this concern in hearings which have been held in our State.

We believe that the primary quality criteria should be to provide water-based recreation and production of fish for sport and human food. We believe that standards on this level will provide the base for effective polution control and best serve the interest of all people, to abate the damage already done.

We believe that priority should be given to the following problem areas, which should be stopped immediately.

1. Industrial discharge of solids.
2. Disposal of wastes high in oxygen demands.
3. Heat loading from manufacturing process and generation of electric power.

The Wisconsin Wildlife Federation realizes that the speed at which any clean-up or abatement can be accomplished is directly related to the monies spent. We maintain that monies spent on pollution control is a payment on an over-due debt to nature and an investment in the future. We urge that the Federal Government as well as participating States insure that adequate monies are made available to effectively carry out a truly effective pollution abatement program.

WISCONSIN WILDLIFE FEDERATION
Mr. Leo W. Roethe, President
Mr. Richard A. Hemp, Executive Director
Box 7
Mosinee, Wisconsin 54455

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WISCONSIN RESOURCE CONSERVATION COUNCIL

MR. WISNIEWSKI: The next communication is one from the Wisconsin Resource Conservation Council. It is addressed to the Conference Chairman.

WISCONSIN RESOURCE CONSERVATION COUNCIL

January 31, 1968

To- Conference Chairman
Lake Michigan Water Pollution Conference
c/o Sherman House
Chicago, Illinois

Statement by- Wisconsin Resource Conservation Council to be included in the record of the conference

The WRCC in meeting at Milwaukee, Wisconsin, on January 20, 1968 passed the following resolution.

1- re-affirms support of the four State Federal Conference January 31 and urges Wisconsin's Governor and State officials to cooperate.

2- urges the FWPCA not extend the deadline date of December 31, 1968,for treatment facilities by Indiana steel mills.

3- urges FWPCA not approve State standards that extend nutrient control for 10 years.

The reason for #3 is the following quote from "Water Control News,"10/16/67, Commerce Clearing House,Inc.

"The State programs of Illinois, Michigan and Wisconsin which call for a deadline for control of nutrients in Lake Michigan are incredibly short-sighted and could stamp the seal on the death warrant for Lake Michigan, according to Superintendent

Vinton Bacon of the Metropolitan Sanitary District of Chicago."

A Classification of "partial body contact" for Wisconsin rivers; the Fox, Oconto and Peshtigo would mean that these rivers are unfit and unsafe for total body contact. This is not cleaning up the water but rather, it tends to legalize already existing pollutions that are well on the way to destroying Lake Michigan.

Martin Hanson, Secretary
WRCC
Box 707
Mellen, Wisconsin 54546

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MR. WISNIEWSKI: The third statement comes from the City of South Milwaukee.

February 2, 1968

STATEMENT OF POSITION AND POLICY FOR THE CITY OF SOUTH MILWAUKEE, WISCONSIN,REGARDING WATER POLLUTION CONTROL IN THE LAKE MICHIGAN AREA

The City of South Milwaukee, Wisconsin, wishes to congratulate the Secretary of the Department of the Interior and the governing bodies of Wisconsin, Illinois, Indiana, and Michigan on actively pursuing the problem of water pollution of the Lake Michigan area by holding this Conference.

The City of South Milwaukee highly approves of the goals of the Federal Water Pollution Control Act and of the steps, such as this conference, being taken to implement this Act.

We are in accord with the spokesmen for the several governing bodies involved who presented statements at the initial meeting of Wednesday, January 31, 1968, urging the direction this Conference should endeavor to take.

We also agree wholeheartedly that it is not enough to set standards and timetables for achieving said standards without each individual governing body taking a long hard look at their own areas to see in what ways their water pollution control measures may be strengthened. Such is the case with the City of South Milwaukee.

We have, in the past seven years, undertaken various studies of our own sewage treatment facilities to provide us with a complete appraisal of existing treatment methods and recommendations for a higher degree of treatment. At this time, plans and specifications are being designed for a secondary treatment facility that will conform to the standards set by the State of Wisconsin Department of Resource Development. We anticipate submitting these plans and specifications to the State and Federal authorities before July of 1968 and further to begin construction of the facilities by early 1969.

It is our policy to comply in every way with the standards that are properly set by the State of Wisconsin in conjunction with the Federal Government.

We believe that only through active participation in the establishment and implementation of sound water pollution control standards can the problem of pollution be conquered, and we strongly urge all governing bodies concerned in the Lake Michigan area to play an active part in establishing the necessary criteria for control of water pollution and also to abide by these criteria in evaluating and renovating their own water pollution control facilities.

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MR. WISNIEWSKI: The next communication is not directly addressed to the Conferees, but it is of interest because it shows the position of the Milwaukee Board of Harbor Commissioners relative to the problem of dredging.

STATEMENT OF
BOARD OF HARBOR COMMISSIONERS
MILWAUKEE, WISCONSIN

January 24, 1968

To the Committee on
Buildings-Grounds-Harbors
Common Council
City of Milwaukee   Re File Number 65-2979-c

Gentlemen:

The Board of Harbor Commissioners appreciates the courtesy of Chairman Lanser, in having furnished the Board copies of the letter of December 5, 1967, addressed to your honorable committee by the Division of Economic Development.

In the preparation of a ten-year port development and land use plan, the Harbor Board was instructed to collaborate with the Commissioner of Public Works, the Department of City Development and the Economic Development Division, because of related municipal planning considerations. Such collaboration was invited by the Harbor Board and was fully received, including close consultation with the Expressway Commission and the City Engineer, so that lakefront expressway plans could be fully oriented with outer harbor plan projections.

The Commissioner of Public Works and the Director of City Development have evidenced their collaboration and approval by appending their signatures to the joint report which transmitted the ten-year plan, which awaits hearing and detailed consideration by your committee.

The Economic Development Office suggests that before the harbor plan achieves "long-range program status" it should include the following:

Extensive market analysis of future port business;

List of priorities with dates of implementation;

Estimates of costs, justified by future benefits to accrue;

The Economic Development staff suggests "we must approach this prospect by paying the strictest attention to the dictates of sound economic considerations." We might observe that the Harbor Board and its staff have always been guided by the dictates of sound economic considerations, one evidence of which is a municipal port investment of $20 million, with a sound market value of $35 million. Another evidence is land purchased or made at low cost, upon which market values of up to $60,000 or more per acre are now controlling.

Port development and the shipping business are volatile, full of variables and subject to many forces of change. Lake and ocean shipping are both going through a rapid-fire technological revolution, which is having a considerable impact upon ports and shipping methods. We wish it were possible to match a physical development plan with a neat, concise package of projections, with a precise sequence of events. Unfortunately, neither the Division of Economic Development nor the Board of Harbor Commissioners possesses a crystal ball which foretells what industry X, ship line Y, or warehouse Z will do to expand, contract or change. We must deal with trends and probabilities, as all other planning agencies must.

The Board and the Port Director can see little justification for costly economic studies.

MILWAUKEE HARBOR COMMISSION

A considerable amount of source material is available which can be drawn upon, including our own experience and trends in the Port of Milwaukee; major traffic studies by the U. S. Corps of Engineers; Seaway traffic studies by Stanford University and others; and recent consultant studies for other lake ports.

The data and projections of these studies can be recast for interpretation by the Port of Milwaukee. We might point out that thirty years ago the sizable land mass of Jones Island was relatively virgin and today we could not fit a new marine enterprise into a half acre site on Jones Island in proximity to deep water. Small parcels remain for development, far removed from water and therefore limited in their use. We have no fears that land now or later to become available from development of the North Harbor Tract won't be fully utilized. The effect of lakefront expressways will, of course, be to make the Milwaukee outer harbor accessible as never before, and we predict a high demand factor for all lands available, with substantial returns to the City.

However, problems of greater moment than those suggested by the Economic Development Division now confront the City Government and the Harbor Board. We refer to the interrelated problems of channel maintenance, disposal of dredging silt, and possible effects on water quality in Lake Michigan. These questions are the subject of intense study by the Corps of Engineers, the Federal Water Pollution Control Administration, cities, states, and port authorities. The file before you, and the ten-year plan, contemplates the building of retaining structures, and the making of land, in an orderly projection for future development. In the very near future, Milwaukee and every other major lake port may be dealing with a question of land fills, in terms of providing reservoirs for dredged material. If restrictions are placed upon deposit of dredging silt in deep water in the Great Lakes, there will be two alternatives:

(a) to dispose of such silt by creating reservoirs in which it can be placed, which means impervious walls, and which could result in the making of new lands, although not necessarily of the highest quality

(b) the second alternative will be to terminate dredging, to let the harbors and channels silt up, and to see port cities wither on the economic vine.

The Board therefore suggests that the ten-year port development plan and the questions raised by the Economic Development Division be held in abeyance for some months, to permit further investigation of future Federal, State and local policy with respect to dredging and silt disposal. The emphasis on land fills for port development may change completely in the near future, and we therefore suggest the City Government consider this as a most important open question for continued close study and observation. As soon as preliminary judgments can be had relating to the interrelationship between water pollution and dredging procedures, we can then make judgments as to the procedures and alternatives which confront the City in these matters.

Respectfully,
BOARD OF HARBOR COMMISSIONERS
(Signed) H. C. Brockel
H. C. BROCKEL
Municipal Port Director

HCB:jlv

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MR. WISNIEWSKI: This completes the reading of the four communications which were directed to the Wisconsin Department.

MR. HOLMER: Thank you, Mr. Wisniewski.

Mr. Robert A. Ewens, the Executive Vice-President of the Wisconsin Manufacturers' Association has a statement to present at this time.

STATEMENT OF ROBERT A. EWENS
EXECUTIVE VICE-PRESIDENT
WISCONSIN MANUFACTURERS' ASSOCIATION

MR. EWENS: Mr. Chairman, ladies and gentlemen.

We welcome the opportunity to appear before this Conference as the representative of more than 1500 Wisconsin manufacturing plants, all intensely concerned with the problems of pollution.

Wisconsin is justifiably proud of its position within the American economy as both an agricultural and an industrial state. Wisconsin industry has flourished not only because of the aptitude and ingenuity of its industrial leaders, but also to a great extent because Wisconsin facilities for "The Good Life", including the availability of abundant and beneficial water and other recreational resources, have attracted to Wisconsin in increasing numbers manufacturing subsidiaries of many out-of-state companies.

I may say that of the Fortune 500 largest corporations in America, 107 have established plants in our state.

Wisconsin industry is vitally interested in preserving those resources as a major factor in the successful growth of its industrial economy.

The report of the Wisconsin Department of Resource Development establishing standards and setting deadlines for compliance on interstate waters has been on file with the Federal Water Pollution Control Administration since last June. Its recent approval by the Department of the Interior permits the acceleration of prompt and efficient effort by both government and industry to attain the standards of water quality desired within the allotted time.

It is worthy of note that of the 17 sources of Lake Michigan pollution identified and scheduled for remedial action in the report, only five are industrial installations:

One involves a problem of septic tank overflow upon which action is already in process;

One involves the primary treatment of an industrial discharge by October 1970;

One involves the neutralization of acid cleaning wastes for which no present recommendation is made;

Two involve the discharge of manufacturing wastes for which adequate treatment is scheduled before October 1970.

Of the remaining 12 identified sources, 9 are municipal sewage operations, almost all of which involve the separation of combined sewers, probably the most frustrating and most expensive water pollution problem facing the Nation today. These are scheduled for final compliance by 1977.

The remaining three are a private school, a commercial laundry and a public restaurant, all involving sewage and septic tank improvements.

The full picture of Wisconsin's part in the Lake Michigan problem is not complete, however, without reference to

(1) The Menominee River, a boundary river

between Wisconsin and Upper Michigan which supports four installations identified as potential polluters of the lake. Two are paper companies involved in the proper disposal of fiber, bark and chemical waste for which no additional requirements are presently recommended. The remaining two are municipal sewage systems facing secondary treatment and combined sewer problems scheduled for correction in 1970 and 1977, respectively.

(2) The great industrial complex along the Fox River which empties into that extension of Lake Michigan known as Green Bay -- an area of which we in Wisconsin are doubly proud (the second basis of our pride is its paper industry which, in the light of this Conference is receiving as much publicity as our other great asset -- the Green Bay Packers). Surveys of the pollution problems of this area are approaching completion and promise to be both extensive and comprehensive. This particular area has been among the most active and progressive in the Nation in combatting the problems of water quality over the past several decades, with many millions

expended in plant investment voluntarily and without governmental harassment for the abatement of a unique pollution problem. Our great paper industry which will be the subject of a separate report before this Conference has worked and continues to work intensively to preserve to Wisconsin the heritage of water resources amenable to public and private use and enjoyment. (3) Probably the most obvious ommission in the picture of Lake Michigan water quality is the contribution of Wisconsin agriculture, and indeed, of agriculture throughout the Great Lakes area, to the pollution of our inland seas.

To date, we have no reliable method of identification or measurement of this source of lake pollution, nor to be equally frank, do we have any workable program to combat the problem.

Except, perhaps, what we have known all along -- proper agricultural husbandry.

Having been advised that any substantial rainfall within 48 hours following the application of agricultural fertilizer will result in a run-off and loss of up to 60 percent of the nutrient value of that application, one might anticipate that agriculturists would schedule their fertilizing operations either long before or immediately following a cloudburst.

The reliability of rainfall forecasts over a three-day period is a question for meteorologists -- not for farmers nor, indeed, for this assembly. We are faced with the fact that the present state of weather and agricultural science offers little immediate hope of solving this aspect of our pollution problem.

The burden, therefore, falls upon the municipalities and upon industry. Their pollutants are readily identifiable, accurately measureable, and to some extent combatable.

Our main concern is that in imposing that burden, economic sanity should prevail -- for under our present system of municipal financing, industry must carry a double burden in the field of pollution abatement:

(1) The massive investment required for corrective measures within the manufacturing process itself.

(2) The substantial participation as major taxpayers in most communities in the financing

of improvements of municipal sewage facilities.

This double cost cannot be passed on to any worthwhile extent in the form of increased prices for industrial products. Under our traditional and, I trust, eternal system of free enterprise and free competition, Wisconsin manufacturers saddled with a large and sudden increase in their cost of production cannot effectively peddle their goods in competition with manufacturers in other areas currently free of comparable expenditures.

In addition, the problems and the cost of abatement of pollution vary not only from industry to industry, but within the same industry in different locations. The technology of pollution abatement in the Gary steel mills is vastly different than that applying to the commercial duck farms near Racine, Wisconsin. As the problems and the solutions vary, so does the cost of improvement vary from plant to plant and from state to state.

The final question is the individual company's ability to absorb or pass on the added cost of pollution control, and upon that question hinges the success or bankruptcy of that company.

The cost, therefore, we urge, must be

imposed gradually and reasonably. To use an analogy to our friends in the dairy industry:

> An economical cow can be expected to produce about 900 gallons of milk in the period of a year. If she doesn't, she should be culled from the herd. Try to pump that same gallonage out of her in a week or a month, and you will wind up with a dead cow.

The moral applies equally to the manufacturing industry. A well-managed company that has managed to stay in business under present economic conditions should be expected to solve its problems of pollution over a period of time without suffering a fatal blow to its financial statement. Try to force the financing of pollution control in a shorter period, and you will wind up with a dead company.

Part of the problem of industrial pollution turns on the adequacy of municipal facilities to handle the waste of the entire municipal population of which industry is an important part.

This is clearly illustrated by the problems of Peter Cooper Corporation in Oak Creek, Wisconsin, which has for some time been committed to connect to the South Shore Metropolitan Sewage facilities. The extension of those facilities to the plant has been delayed, however, pending proper financing -- a part of which is involved in a long-pending application by the commission for Federal assistance. If we read the signs accurately, the financing and the solution of this particular problem will be achieved before the year's end, two years ahead of the Wisconsin deadline.

Part of the problem industry faces in its efforts to combat pollution can be traced to questions of changing technology in the pollution field and, until recently, the lack of local standards to be achieved.

This is illustrated by the circumstances of J. I. Case in Racine, Wisconsin, which voluntarily and without governmental urging installed an air cleaning system in its foundry operations employing the best known technology then available, and now finds itself apparently contributing to the pollution of Lake Michigan via the discharge of fine black sand collected through its excellent air cleaning installation. This problem has fortunately now been eliminated by trucking the filtered residue to an approved dump site where perhaps some new aspect of pollution will later be discovered.

This company in particular has long worked with State, County and local authorities to solve problems of disposal of non-sewage waste, run-off from downspouts and the erosion of lake frontage through the natural interaction of wind and wave. Having been "burned" in the course of voluntary corrective measures, the company might be expected to sit back and wait for explicit governmental direction. Such is not the case, however. J. I. Case has further developed its continuing program of correction and improvement, with the assistance of high grade professionals, and has submitted its future plans to the Wisconsin Department of Resource Development for further suggestions and approval while continuing its day-to-day efforts to solve problems of air and water pollutions within its plant and in the Racine community. One of its problems is the preservation of its Lake Michigan shoreline, seriously eroded as a result of natural phenomena, and the reconstruction of that shoreline, a problem involving some rather tricky legal problems of title vis-a-vis the State Government.

With continuing cooperative effort, however, J. I. Case anticipates complete solution of known pollution problems within the established 1970 deadline at a cost now estimated in excess of $3 million in direct company expenditure alone. What its cost of municipal improvement will be is still a matter of conjecture.

We therefore in Wisconsin hope to apportion the financial burden of pollution abatement equitably between industry and the rest of the tax-paying public so we may preserve and expand Wisconsin industry as a major basis of our economy.

We ask only that we be permitted to approach our problems in the light of our own peculiar circumstances -- circumstances which may at first glance appear similar to those pertaining in our sister states here represented, but markedly distinguished by our topography, our location, our type of industry and our economy from those in Illinois and Indiana and, to a lesser degree, from those in Michigan.

Wisconsin industry has demonstrated and here reaffirms its willingness and its ability to work cooperatively with its state authorities and with its counterparts in the other Lake Michigan States toward the goal we all seek:

The preservation and enhancement of our common heritage in Lake Michigan and in the other interstate waters which serve and support our pursuit and enjoyment of the good life in Wisconsin.

Thank you very much for the opportunity to address you.

MR. STEIN: Thank you, Mr. Ewens.

Any comments or questions?

MR. KLASSEN: I am interested and I would like the speaker's opinion or comment on the statement at the top of Page 5. I raise this point, and I would like his comment on it.

It tells about a company staying in business and "should be expected to solve its problems of pollution over a period of time"--I want to add this is a little vague--"without suffering a fatal blow to its financial statement."

I want to ask this speaker if he feels that a company should refrain from spending money for water pollution control and at the same time be paying dividends to the stockholders? Is this part of what you mean by a blow to its financial statement?

In other words, is, in your opinion, it

compatible for a company to say, "We can't finance improvements or put in adequate treatment works and at the same time pay dividends to its stockholders"?

MR. EWENS: No, I didn't mean that. I meant that the company should not be operating on a deficit basis. I have no connection with dividends.

But speaking of dividends, it is a fundamental of economics that you have got to have capital for improvements, and capital is only attracted to industry if there is a potential income to be realized.

What I am urging this group is give us time, like all improvements in any capital structure, in improvements in the manufacturing process.

I was interested in reading in the paper coming down on the train to Chicago this morning that one of the reasons why Mr. Knudsen has left the Executive Vice-Presidency of General Motors to become the President of the Ford Motor Company was that in his opinion General Motors' management was in error in not planning longer than four years in advance as to what General Motors was going to do.

And so what I am urging on this pollution problem, industry will solve it, but it has to have time and financing to do so.

MR. KLASSEN: Do you have any estimate on the time that we should wait? We have kind of waited a long time already.

MR. EWENS: I quite agree with you, but I don't think you can generalize on time. I think each individual plant has to be studied separately.

MR. STEIN: Are there any further comments or questions?

MR. MITCHELL: On the top of Page 7 you indicate that we should "apportion the financial burden of pollution abatement equitably between industry and the rest of the tax-paying public." I might direct your attention to a new law we passed in Indiana which allows our industrial people to construct waste treatment facilities and then not have those placed on your property tax rolls, which gives them an incentive to construct those waste treatment facilities. And we found that in working with some of our industrial people that there has been a renewed interest in them meeting their obligation.

MR. EWENS: Thank you, sir. I want a copy of that law, and I will get it.

MR. STEIN: Are there any further comments or questions?

Mr. Holmer.

MR. HOLMER: I want to thank the other Conferees for asking the questions that were on my mind.

MR. STEIN: Mr. Poston.

MR. POSTON: I have a question, particularly since Mr. Klassen asked about time of compliance with recommendations and abatement.

On Page 2 you indicate that there are 17 sources of Lake Michigan pollution identified and only 5 of these are industrial sources.

MR. EWENS: Yes, sir.

MR. POSTON: I know that in this Conference we are talking about the total of the Lake Michigan Basin, and in this respect I think those on the Fox River would be considered as pollution sources that affect Lake Michigan, at least from the standpoint of phosphates, nutrients. I wondered if these industries are aware of their effect on the lake and have intents to take remedial actions also.

MR. EWENS: I am sure they are, and I am sure the gentleman who will speak here for the Paper

Industries can answer you more directly on that.

MR. STEIN: Mr. Ewens, I certainly agree that industry should be given a reasonable time, and I think the Conferees, both in a State program and in our Federal-State program, have generally given industry a reasonable time. I think we have a record here, at least in the Federal enforcement cases, of dealing with some 1200 industries throughout the country, and I didn't hear too many complaints when the time schedule was set as to the time.

But once a reasonable time schedule is set, I wonder what the record of industry should be in meeting that time schedule?

MR. EWENS: If it is reasonable, I think it should be complied with.

MR. STEIN: I think it should. But I think if we look at the record, you will find a considerable amount of pressure for extensions and slippages, and this is something I think that has to be kept in mind. Once a reasonable time schedule is set, I think industry has an obligation to meet it.

MR. EWENS: I quite agree if the test of reasonableness is applied.

MR. STEIN: Yes.

MR. HOLMER: Mr. Ewens, I have one more question. This is of a philosophical nature, but going to the heart of your statement. Should a firm which is operating at a deficit be permitted to continue to operate if it has not met its pollution abatement responsibilities to the community? Do you view pollution abatement as a high priority expenditure on the part of the company and one of the first obligations of the company?

MR. EWENS: I do indeed. I certainly don't think that extensions should go on indefinitely for a company that is eternally running in the red. I think it should be a No. 1 consideration on pollution.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: Thank you very much.

Mr. Holmer.

MR. HOLMER: Representative of some of the industries on the Fox River and all of the Pulp and Paper Industry in the Lake Michigan Basin is Richard Billings, of Neenah, Wisconsin.

Mr. Billings.

MR. STEIN: While Mr. Billings is coming up, I would like to welcome him. Again he represents an industry with a tremendous pollution problem, represents people sometimes who have had philosophic differences with the regulatory agencies, and he also represents an industry that has to, if they are going to comply with what the regulatory agencies are going to ask, spend considerable amounts of money.

I might say, though, given these things, it has been a pleasure to work through the years with Mr. Billings because we know he has had complete candid exchange of views and information both from government sources and industry sources. I would like to say in the most hotly contested cases we have never found any difficulty in getting information on waste discharges or production from the pulp and paper industry, and I don't think they have had any trouble getting that information and exchange of views from us. I think in every recorded case, we have been able to work out solutions.

I think Mr. Billings is to be commended for the highest type of industrial statesmanship in what admittedly very often is a very difficult area.

Mr. Billings.

MR. BILLINGS: Thank you very much, Mr. Stein.

That is truly praise from Olympus.

STATEMENT OF RICHARD M. BILLINGS
REPRESENTING THE
WISCONSIN PULP AND PAPER COMPANIES

MR. BILLINGS: Mr. Chairman, Conferees, Ladies and Gentlemen.

My name is Richard M. Billings. I am Assistant to the Vice-President - Research and Engineering, of Kimberly-Clark Corporation. I am making this statement as spokesman for the paper companies representing 80 percent of the pulp and paper production in the Wisconsin segment of the Lake Michigan drainage basin. The companies are listed at the end of this statement.

Of the Nation's 47 paper-producing States, Wisconsin ranks first in sales, first in tonnage produced, first in capital investment, first in taxes paid, and number of people employed. It has been a principal industry of the State since before 1900. It has assets of over nine hundred million dollars and employs one out of every 11 industrial workers in Wisconsin. Its continued growth and well-being are vitally dependent upon its continuing ability to make economic use of the water resources upon which its processes depend. It is concerned with the quality of the water coming to it as well as the effect of its effluents on the onflowing river. It has, therefore, been a leader for many years in the study and solution of water quality problems, and in the abatement of pollution.

Wisconsin was one of the first States to become concerned with water quality and its management. Legislative action was recorded as early as 1899. The Committee on Water Pollution was created by the legislature in 1927 and was one of the first interdepartmental pollution control agencies in the U. S. It has developed a broad range of basic data and has been a national leader in the development of water quality control and pollution abatement programs.

The Wisconsin Division of Resource Development (successor to the Committee on Water Pollution) thus has in its files today a record of stream conditions in Wisconsin extending over a period of 39 years. It is intimately familiar with the history of population growth, expansion of manufacturing, and their effect upon water quality. The State is also familiar with the economic implications of any water quality control measures. It is, therefore, uniquely qualified to establish practical and enforceable water quality standards for Wisconsin's interstate waterways and for the intrastate waters which form a part of interstate drainage basins.

The Wisconsin pulp and paper industry has a long history of active participation in pollution reduction and control. It established a liaison committee at almost the same time that the State Committee on Water Pollution came into being. The industry committee has acted in an advisory capacity to the State and has enabled the State to broaden its efforts.

In addition, the paper industry has for many years joined forces with the State in making cooperative river surveys. This assistance of industry engineers, chemists and technicians has made possible State surveys of river flows and current measurements, of biological studies and chemical analyses to a greater extent than would have been possible otherwise.

In 1939, thirteen Wisconsin mills formed the Sulfite Pulp Manufacturers Research League, which has since expanded its scope to cover all chemical pulping processes. The League, which is financed by the paper industry, established and operates a unique research laboratory. It has done the research and accumulated the basic information upon which the individual mills have developed specific pollution-abating by-products and processes. The League itself has also originated or pioneered the following pollution abatement facilities or practices:

1. Developed the process for producing Torula yeast from spent sulfite liquor. The first such yeast plant in Wisconsin was started by the League.

I might add that this is the first of its kind in the Western Hemisphere.

2. Developed the theory and procedures that have made possible the yearly utilization of millions of gallons of spent sulfite liquor as roadbinder.

3. Pioneered the first successful spent calcium base sulfite liquor evaporation system in the country, thus developing the basic information necessary to construct today's installations employing this abatement process.

4. Worked out with the inventor a practical method of utilizing hydroelectric turbine installations for the reaeration of rivers. Tons of oxygen added to Wisconsin streams each day of the critical summer period are the direct result.

Current basic studies aimed at pollution abatement include methods of production of wood sugars, adhesives, and dispersants. Processes such as reverse osmosis have attracted national attention resulting in a contributing FWPCA grant for feasibility studies. Electro-dialysis, developed by the League for the paper industry, has proven adaptable for pollution abatement in the dairy industry.

Most Wisconsin pulp and paper mills belong to and finance the efforts of the National Council for Stream Improvement, founded in 1943, which has also pioneered in the treatment of pulp and paper mill wastes. The specific application of clarifiers, aerators, activated sludge ponds, spray disposal systems, aerated and stabilization lagoons to pulp and paper mill wastes is in most instances the result of recommendations and advice of the National Council Staff of engineers and chemists.

Information on pollution abatement developments is also exchanged regularly between companies. For this reason, the mills of the industry across the Nation act as a broad testing ground and reservoir of abatement experience. In the highly competitive pulp and paper industry of today, pollution abatement is one field where no competitive barriers exist.

The Institute of Paper Chemistry in Appleton furnishes bioassay and biological stream surveys which are of tremendous importance in the industry's efforts to minimize and control pollution.

In the area of biological stream surveys, in the last ten years alone, the Institute has studied intensively 7,500 miles of streams, rivers, swamps and lakes across the length and breadth of the Nation.

The cost of the foregoing efforts to the industry has been high. The Wisconsin Department of Resource Development's annual summary of capital expenditures for paper industry facilities which resulted in or were intended to result in reductions in pollution -- this is the old Form B and now Form WR-8 -- indicate that 36.6 million dollars was spent in the last ten years, and that research costs were

7.5 million dollars over this period. This is only part of the story, however. Yearly operating costs of the average effluent treatment installation run about 15 per cent of the original capital expenditure. These costs continue as long as a mill is in operation.

The opening section of the Federal Water Pollution Control Act states:

> "..., it is declared to be the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States in preventing and controlling water pollution, to support and aid technical research relating to the prevention and control of water pollution, and to provide Federal technical services and financial aid to State and interstate agencies and to municipalities in connection with the prevention and control of water pollution."
>
> (33 U.S.C.A.§ 466)

This statement of policy, which emphasizes the secondary nature of Federal involvement in the area of water quality control, is fundamental to the consideration of the questions here presented and to any recommendations,which you as Conferees ultimately make.

With respect to interstate waters, the Federal Act provides that the States shall

> "adopt (A) water quality criteria applicable to interstate waters or portions thereof within such State, and (B) a plan for the implementation and enforcement of the .. criteria adopted ..."

Action by the Federal Government is restricted where effective State programs and standards of water quality exist. All of the States present here as Conferees have in fact developed and submitted the requisite standards and programs within the time required.

Since the development and submission of the Wisconsin program, members of the Wisconsin paper industry have continued to work on pollution-abatement projects consistent with the Wisconsin program, even though Federal approval was not received until last week. As evidence of this continuing effort, statements by or on behalf of paper companies at the hearing on the lower Fox River held January 18, 1968, in Appleton, Wisconsin, are appended hereto as exhibits.

Mr. Chairman, I would like to have these added to the minutes at this time.

MR. STEIN: Without objection, these will be included as exhibits.

MR. BILLINGS: In view of the record of action by the States in response to the provisions of the Federal Act, we feel that the timeliness of this Conference is open to question.

Wisconsin standards and plans for enforcement were submitted only last June, and were approved only last week. Certainly insufficient time has elapsed to determine the adequacy of Wisconsin's program for abatement and whether or not any delays are being encountered. These are two of the three statutory mandates to this conference. The other, occurrence of pollution of interstate waters, might be a more relevant subject of inquiry after State standards and enforcement procedures had been in operation long enough to determine their effect on present pollutional situations, which are already well documented.

The House Appropriations Committee, in a report dated July 20, 1967, says:

> "As the power to control water quality and quantity is not only the power to make or break business and agriculture but is a power over the life of the Nation itself, it is essential that

the Federal Water Pollution Control Administration not only closely coordinate its plans and activities with all the Federal agencies involved, but also with each of the States, local jurisdictions, and private interests affected by the program. The imposition of restrictions and controls without full and equitable consideration of the essential and varied interests involved in water supply, including priority of use and riparian rights, could have a most serious adverse effect on the various segments of the economy dependent upon water for their existence."

(90th Congress 1st Session
H.R. Report #505, Page 80)

This statement constitutes a solemn warning of the dangers of action without adequate consideration and understanding of the future consequences and the evaluation of potential complications.

It is certainly relevant in considering the report of the Federal Water Pollution Control Administration of January, 1968, entitled, "Water Pollution Problems of Lake Michigan and Tributaries" which purports to be the working document for this Conference.

This report, to the extent that it makes recommendations of standards and necessary treatment, is certainly premature. Further, we respectfully submit that it constitutes a perfect example of that kind of approach which the Appropriations Committee, in its statement warns us to avoid.

Nowhere in the FWPCA report is there an indication that any study of the cost of implementing its recommendations or the benefits to be expected therefrom has been made. Neither is there any consideration of the economic burden on those who would be required to implement them.

We take serious exception to the recommendations contained in the Report (pp 65 et seq) and particularly to general recommendations Nos. 4 and 5 and by implication the principle expressed in No. 2.

These recommendations appear to require an arbitrary degree of treatment whether or not the magnitude of the discharge is gallons per day or millions of gallons per day, whether the receiving stream is a trickle or a torrent, and whether it is in the center of a forest or the heart of a city. Such recommendations attempt to enforce a standard treatment, even when the stream classification, no matter how stringent, is being met without it. This is requiring treatment for treatment's sake. It would require the spending of substantial sums of money which in many instances would create little or no benefit to anyone.

The recommendations of the FWPCA for uniform treatment, regardless of need, will have the same effect as uniform effluent standards. This would appear, therefore, to be in direct violation of the intent of Congress, which in considering the problem of pollution and pollution abatement, rejected uniform effluent standards in favor of stream classification, as the wisest and most appropriate avenue to the optimum use of our Nation's streams.

We also question the inclusion of the arbitrary timetable calling for plans within six months and completion within thirty-six. This is totally unrealistic. Intelligent plans for treatment must be based on laboratory and pilot plant studies. The adaptability and workability of new principles must be demonstrated before they can be planned on a production scale. The FWPCA itself has made numerous grants calling for studies expected to require two years or more for completion. These grants include Project WPRD 60-01-67, a study and evaluation of four alternative biological procedures for treating combined municipal and pulp and paper mill wastes by the Green Bay Metropolitan Sewerage District and four paper mills, and WPRD 12-01-68 with the Pulp Manufacturers Research League for the evaluation of the treatment of pulp mill wastes by reverse osmosis.

The arbitrary timetable approach for all recommended action in the entire Lake Michigan basin area if nothing more endangers the development of sound technical information, discourages thorough planning, and encourages careless expenditure of government and private funds. It also ignores the relative importance of specific problems or projects, and the very real need for priorities in their planning and completion.

To the extent that these remarks may have seemed critical, I trust that they will be accepted as being constructively critical and will be helpful to the Secretary and the Conferees in arriving at recommendations on how best to proceed toward the attainment of common goals.

We believe that economic studies and cost-benefit comparisons are essential to an intelligent attack on water quality problems. Pollution control is far too serious and costly to be undertaken without first making such evaluations.

We believe that great opportunities for progress lie in the development of newer, more efficient, and less costly methods of treatment and waste disposal. We offer the results of our research in these areas to all who may benefit, and urge you to encourage, in every way possible, more and broader research of this nature.

Our criticism of the FWPCA report is not directed at those who prepared it, since we do not know the nature and scope of their assignment. Our suggestions are based on the premise that as the basic working document of this Conference, it contains serious omissions and makes arbitrary recommendations without factual support either in terms of need, economic feasibility, or time required. We urge you to recommend that these omissions be rectified.

We agree wholeheartedly that there is need for continued active effort to control and abate pollution and we welcome the growing public awareness of the existence and complexity of the problems.

In conclusion, while we will oppose strenuously the establishment of programs without regard for actual need, and those that impose arbitrary criteria, standards, timetables, and regulations, we are prepared to throw the weight of our industry behind the development of well-considered and practical pollution control programs.

We will continue to give strong financial support to research in pollution control techniques. We welcome the assistance and will cooperate with Federal, State and local governments in the development of new and advanced control methods. As such methods come into being, we will continue to adapt them to our specific problems and bring new installations into operation. While much has been done, we agree that more can be done. We urge, however, that these steps be made wisely, not in haste, and only after full consideration is given to the consequences.

SUBMITTED IN BEHALF OF:

AMERICAN CAN COMPANY

BADGER PAPER MILLS, INC.

CHARMIN PAPER PRODUCTS COMPANY
COMBINED PAPER MILLS, INC.
CONSOLIDATED PAPERS, INC.
FOX RIVER PAPER CORPORATION
GILBERT PAPER DIVISION, MEAD CORPORATION
GREEN BAY PACKAGING, INC.
KIMBERLY-CLARK CORPORATION
NICOLET PAPER COMPANY
RIVERSIDE PAPER CORPORATION
SCOTT PAPER COMPANY
JOHN STRANGE PAPER COMPANY
THILMANY PULP & PAPER COMPANY

(The exhibits submitted by Mr. Billings are as follows:)

CONFERENCE IN THE MATTER OF POLLUTION OF LAKE MICHIGAN
CHICAGO, ILLINOIS JANUARY 31, 1968

EXHIBIT I
to the
STATEMENT OF WISCONSIN PULP & PAPER COMPANIES

RICHARD BILLINGS

STATEMENTS BY OR ON BEHALF OF
PULP AND PAPER COMPANIES
PRESENTED AT THE HEARING
ON THE LOWER FOX RIVER
JANUARY 18, 1968
BEFORE THE
WISCONSIN DEPT. OF NATURAL RESOURCES,
DIVISION OF RESOURCE DEVELOPMENT

STATEMENT BY AMERICAN CAN COMPANY
GREEN BAY, WISCONSIN

My name is Martti Lundstrom. I am Mill Manager of American Can Company's mill in Green Bay. At Green Bay our company operates a Sulphite and Groundwood Pulp Mill, a Paper Mill and related Converting Operations producing sanitary tissues, paper towels and napkins. At this operation we employ approximately 1,200 people with an annual payroll between $9 and $10 Million. In addition we operate a Pulp and Paper Mill at Rothschild, Wisconsin and Paper Mills at Ashland, Wisconsin and Menominee, Michigan.

Our company has had a long history in cooperating with State authorities and in the implementation of a progressive water pollution abatement program. As an example, the American Can Company in 1953 installed spent sulphite liquor evaporators resulting in an immediate reduction of about 50 per cent in the amount of BOD discharged from the sulphite pulping operation. During the ensuing years there has been a continuing downward trend in BOD discharge from this source. In recent years the capacity of the evaporators has been increased by improved instrumentation and controls, increased heating capacity, installation of an improved chemical cleaning system and a flash cooler.

Most recently, improved collection of spent sulphite liquor has been realized through a change in processing this product.

In 1960 the American Can Company put into operation a settling lagoon system, the primary purpose of which was to bring fiber losses to a level below 1 per cent of total mill production. Figures given in the Annual Survey Reports received from the former Committee on Water Pollution (State of Wisconsin) show that our total fiber losses have consistently been less than the 1 per cent goal. As an example the years 1965, '66 and '67 show 0.87per cent

0.86 per cent and 0.88 per cent respectively. Figures taken from in-plant measurements during the past six months indicate the settling lagoons are 90 per cent plus effective in removing settleable solids. This per cent efficiency would indicate that the lagoons are performing as they were intended.

Also in 1960 we installed our original spray dryer for processing concentrated spent sulphite liquor. This capacity for producing spray dried products was doubled in 1965 by the installation of a second spray dryer.

In June of 1966 a paper machine was shut down. One of the principal reasons for discontinuing operations on this machine was the high fiber loss during its normal operation. Economic studies indicated we could not justify the cost of modernizing this machine and its stock system in order to significantly reduce this fiber loss. The shutdown of this machine showed an immediate and substantial reduction in the amount of settleable solids being sent to the lagooning system.

The foregoing installations have all provided the means for reducing wastes discharged from our mill. However, we are continuing our studies toward further improvement. The remaining significant source of BOD discharged from our mill is the weak and uncollectable spent sulphite liquor. As part of our program to deal with this material we have joined with three other mills in the Green Bay area and with the Green Bay Metropolitan Sewerage District in a joint industry-municipal project for treatment of mill effluents which are presently not amenable to processing. Pilot plant studies have indicated that the joint treatment of the effluents involved looks favorable. If successful, there is good prospect for construction of a full scale plant to handle these effluents. When and if such a plant is put into operation, a further substantial reduction in the BOD load from our plant can be expected. American Can Company will carry its fair share of the capital and operating costs of such a plant.

1/18/68

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BEFORE THE
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RESOURCE DEVELOPMENT
PUBLIC HEARING, APPLETON, WISCONSIN
JANUARY 18, 1968

STATEMENT OF
CHARMIN PAPER PRODUCTS COMPANY
GREEN BAY, WISCONSIN
M. J. AUCHTER, VICE PRESIDENT - MANUFACTURING

The Charmin Paper Products Company operates two mills manufacturing sulphite pulp and sanitary paper products at two locations within the City of Green Bay. They are known as the East River Mill and the Fox River Mill. Our Little Rapids Mill, located at West De Pere on the Fox River, was shut down on a permanent basis in October of last year. The Little Rapids employees were transferred to our Green Bay Mills.

Since first testifying for my company on pollutional matters in 1948 and 1949, Charmin's physical plant and capacity has more than doubled. Employment has increased from 815 to 1560. During this period, over ten million dollars has been spent in the construction and operation of our pollution abatement facilities.

BIOCHEMICAL OXYGEN DEMAND

First, I would like to briefly describe our efforts and performance to reduce the oxygen demand on the Fox River. At the 1949 Hearings, Charmin committed itself to the construction of a treatment plant knowing full well that the then known methods for treating spent sulphite liquor were only in an experimental stage. We constructed a Yeast Plant to utilize the wood sugars in the liquor producing feed and food yeast. This plant cost over three million dollars and eventually attained pollution abatement levels approximating 45 per cent to 50 per cent biochemical oxygen demand reduction. After operating more than twelve years, the Yeast Plant was shut down early in 1967. Paper mill expansions begun in the early 1960's had to be supported with increased pulp capacity. It was not practical to process the added spent liquor in the Yeast Plant. We proposed and obtained State approval to construct an evaporate and burn plant. This plant began operations in 1963. Initially, it was operated in conjunction with the Yeast Plant. Later, with improved techniques, we obtained better biochemical oxygen demand removal by eliminating the Yeast Plant from the process.

Our spent liquor collection facilities initially installed in conjunction with the Yeast Plant have been modified to handle the increased liquor flow. Biochemical oxygen demand removal in any treatment system is proportional to efficiency of spent liquor collection. Our collection facilities compare favorably with the best in the industry. The liquor collection and treatment facilities along with other improvements in Pulp Mill operations, have reduced total biochemical oxygen demand by 70 per cent. This compares with the 34 per cent reduction reported in 1957 and the 66 per cent reduction achieved in 1965.

Further improvements are dependent upon completion of several construction projects now underway and development of treatment methods capable of handling condensate from the evaporators and dilute wash waters from the Pulp Mill.

Charmin has long felt that biological processes will attain the highest level of treatment efficiency of dilute wastes. We first initiated research on this concept by jointly treating yeast plant effluent combined with domestic wastes in 1958.

The work was done at our expense in co-operation with the Green Bay Metropolitan Sewerage District on pilot plant trickling filters. This effort was discontinued in 1961 because it proved only partially successful. Reports of this investigation were submitted to the State Committee on Water Pollution at that time. A new approach, again at Charmin expense, was begun in late 1964 utilizing the more modern activated sludge process on condensate and dilute wash waters in combination with domestic wastes. The domestic wastes provide the dilution and the nutrients in the form of phosphorous and nitrogen necessary for successful treatment. The laboratory and pilot plant results were sufficiently promising to interest the three other pulp and paper mills in the Green Bay area. Together with the Green Bay Metropolitan Sewerage District, the four mills are carrying out a co-operative research program financed in part with a Federal Government Demonstration and Research Grant. After the technical and engineering aspects of the joint treatment approach have been worked out, further hurdles must be overcome before this effort can be consummated. However, there is prospect for the construction of a super plant designed to treat a combined effluent load, industrial and domestic, in the Green Bay area. We estimate that such a plant will help us attain up to 85 per cent reduction of our total pollutional load. This is equivalent to secondary treatment and the highest practical degree attainable with present day technology.

SUSPENDED SOLIDS

By collecting excess process water at the East River Mill and pumping it through a pipeline in our tunnel to the Fox River Mill, we have eliminated the discharge of all wastes--biochemical oxygen demand and suspended solids--from the East River. Since 1964, all of our mill effluents from the East River Mill and the Fox River Mill pass through a single effluent measuring station at the Fox River Mill. This station is equipped with modern sampling and analysis equipment.

With our system of fiber and water conservation in papermaking operations, our suspended solids loss from papermaking have for many years been well below the State Committee on Water Pollution Standard of one pound per thousand gallons and 1 per cent of production. Our records indicate our papermaking losses are consistently around 1/2 of 1 per cent.

In September 1965, we started up a flotation-centrifugation-incineration system to dispose of fines from the Pulp Mill. As is usual with new installations, we experienced some operation difficulties in each of the three distinct sections of the system. Flotation and incineration appear now to be under control. We continue to have some problems with centrifugation.

Early in November 1967, we initiated a new program to invest an additional $920,000 in pollution abatement facilities at our Green Bay Mills. This new program scheduled to be completed by May 1, 1968 will allow us to reach 75 per cent biochemical oxygen demand reduction. The program consists of:

. . . more settling tanks, a second centrifuge, additional flotation and screening equipment all directed to reducing the fiber content of waste water,

. . . additional equipment to recover and treat more spent sulphite liquor from pulp making, and

. . . a number of small but important process changes at the East and Fox River Mills, such as better collection of overflows, new instrumentation, piping changes and reduced water usage.

A separate appropriation for approximately $260,000, is being formulated and will be approved in the next few months. These funds will be spent on further reducing paper machine losses and in-plant water conservation measures.

When these programs are completed late in 1968 or early 1969, suspended solids losses from our pulp and paper mill operations are expected to be somewhat less than 3/4 of 1 per cent of production.

SUMMARY

In summary, we believe the record confirms that Charmin has consistently and progressively carried out its 1949 commitments. Further, by mid-1968, we will have achieved a 75 per cent biochemical oxygen demand removal. Our goal in 1972-1973 will be 85 per cent or 170,000# of biochemical oxygen demand removal per day which is equivalent to secondary or complete treatment. This will result in effluent discharge of 30,000 to 35,000 pounds of biochemical oxygen demand per day. Such a degree of treatment, if uniformly attained by all parties concerned, will result in a substantial up-grading of the Fox River and Green Bay to a level meeting the water quality standards proposed by the State of Wisconsin.

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January 30, 1968

Mr. Freeman Holmer
Director, Wisconsin Department
of Resources Development
1 West Wilson Street
Madison, Wisconsin 53702

Dear Mr. Freeman:

Combined Paper Mills, Inc. wishes to file this written statement in response to your notice on investigation and hearing and a report on an investigation of the pollution in the lower Fox River and Green Bay made during the period 1966-67 dated January 4, 1968. Our company does not take issue with the survey findings as summarized in Item 18 on Page 5 of the above report. We wish to indicate our interest and intend to cooperate with the

Department in all matters pertaining to stream pollution.

Our company is an old mill, just under 80 years old, and has had all the problems associated with improving water pollution conditions in an old mill. Since the first orders issued in 1949, we installed four additional savealls and in 1955 installed a primary clarifier. After working with various manufacturers of sludge thickening equipment, we finally installed an Eimco Rotobelt Sludge Filter in 1959, the first application of this type of equipment of deink sludge thickening in the industry. The total cost of the equipment at this time was just under $300,000.00.

Further studies were then instituted for treatment of the deinking waste water to provide secondary treatment for the total mill effluent. Because of the problems associated with the treatment of deinked effluent, this study required two complete summers and part of a third. The primary problem associated with this study was the excessive foaming conditions resulting from the use of a relatively high useage of synthetic detergent. From the data obtained, the Chester Consulting Engineers of Pittsburg, Pennsylvania, were retained to study the data and make recommendations as to the scope of the facilities necessary to successfully treat the total effluent.

Because of the very large size equipment necessary to handle this type of effluent and since the State of Wisconsin passed a law limiting the use of certain types of detergent, our company decided to cease the deinking operation and substitute this with a revolutionary new process for producing a mechanical type of pulp based on the mechanical refining of aspen wood chips after a treatment with a weak chemical solution at relatively low temperatures. The process was chosen because it was based on the use of wood readily available in Wisconsin and also gives a very high yield. As a result, the company ceased deinking operations by August, 1966, and replaced this with the chemi-mechanical pulping operation on a small commercial basis. Initial work on studying the characteristics of these wastes was started to determine what process would provide the best treatment. We now know that the volume of effluent is considerably less on a per ton basis than it was for the deinking process and that the suspended solids are also less than what they were for the deinking process. This summer we expect a full sized plant in operation and will continue our study to determine the process to use to treat the effluent.

The company is installing two additional hydro electric generators at the present time which will have provisions for air venting the same as provided for at three of our present turbines which are used to aerate the water passing through the turbines during the critical river flow periods when approximately 3/4 of a ton of oxygen per day is added to the water.

Very truly yours,

COMBINED PAPER MILLS, INC.

R. A. VOGT

RAV:jmb

STATEMENT OF CONSOLIDATED PAPERS, INC.
PUBLIC HEARING ON FOX RIVER POLLUTION
APPLETON, WISCONSIN

January 18, 1968

I am G.K. Dickerman, Technical Assistant

To The President, Consolidated Papers, Inc., with headquarters in Wisconsin Rapids. Consolidated owns and operates a bleached sulfite pulp mill situated on the Fox River in the heart of the City of Appleton. This plant is capable of producing 150 tons of pulp a day and employs 264 men, has an annual payroll of $1,900,000, and paid $90,000 in property taxes in 1966.

The very substantial pollution abatement program which has been carried out at our Appleton mill strongly supports the written statement of corporate policy which says in part, "As good corporate citizens, we continue to accept our responsibility to preserve and protect natural resources and environment in the areas in which we operate." In keeping with this policy, we do want to see the water quality of the Lower Fox River brought up to the standards for industrial and cooling water, as well as partial body contact and public water supplies, which classification has been proposed between Appleton and Green Bay. We would take issue, however, with those who suggest that this section of river be classified primarily for fish and aquatic life, since this nullifies the basic "multiple use" concept.

RICHARD BILLINGS

I would like to tell you something of what we have done to improve the water quality of the Fox River below our Appleton Division, commonly known as the Interlake mill. Following the public hearings held in Green Bay in December 1948 and 1949, we submitted plans for an abatement program as directed in Order 2-49JA-5. The plan as approved by the State Committee on Water Pollution called for the installation of an evaporator and facilities for burning the concentrated spent sulfite liquor in a furnace especially modified for this purpose. There was no design or engineering experience to draw on in this country for this unique evaporator; therefore, we had to go to Sweden to obtain a design suitable to our special requirements. We estimated our pollution load would be reduced by 40 per cent.

This pioneering installation was completed and started up on January 12, 1953. The cost of the evaporator with associated equipment came to $673,000. Although the economics were unfavorable, the abatement efficiency exceeded expectations and the BOD discharge was reduced from 45 tons a day as shown in the 1949 survey to less than 20 tons, or slightly more than 50 per cent.

In April 1957, there was another Fox River hearing, this time in Appleton. It was followed by Order 3-57J-27 dated October 10, 1957, requesting that we submit plans for further reduction. This time it was stated that our reduction should be on the order of 70 per cent to 75 per cent of the base loading. Studies which had been carried out by the mill technical staff with the assistance of the Institute of Paper Chemistry resulted in the design of improved collection facilities. The plans were approved and the facilities were put into operation in the spring of 1961. We soon realized that additional evaporation capacity would be needed to take care of the improved collection. We installed an additional evaporator at a cost of $220,000. It was started up on October 12, 1962.

Since then we have installed a third evaporator, and although there has been no official determination, we estimated that we have now reduced the daily BOD discharge to approximately 12 tons. These later gains are of less spectacular amounts than the gains of 15 years ago, because the better a mill's performance becomes, the harder it is to take off another increment of pollution.

This recent addition to our evaporating capacity allows us to collect 75 per cent of the spent liquor dissolved solids with an estimated 70 per cent reduction in BOD loading. This met the objective of the State Board of Health and the Committee on Water Pollution as expressed in the series of orders numbered 3-57J issued October 10, 1957, from which I quote: "It appears that a minimum overall reduction of 70 per cent to 75 per cent from raw waste load is needed to gain improved conditions in the receiving water." End of quote.

I want to emphasize that this program would not have been possible based on the original concept of burning all the concentrated liquor. We could not have supported the cost and, furthermore, we were unable to find a satisfactory solution to the problem of fly ash which was critical due to the mill's central city location. Fortunately, an intensive program of research and sales effort led to the development of a by-product market which has been consuming all of the spent liquor we can collect and convert to dry or concentrated form. Our total expenditure at this plant for pollution abatement facilities, including the third evaporator addition installed in 1967, now amounts to over $2,250,000. It is interesting to compare this figure with our total investment for the remainder of the mill of $5-1/2 million.

Only by making heavy expenditures in developing our own technology where none existed, were we able to meet the objective of 40 per cent reduction in compliance with Order 2-49JA-5 issued February 21, 1950. Expansion of the facilities at additional heavy cost enabled us to meet the escalated objective of 70 per cent to 75 per cent reduction from the raw waste load. Our progress, while substantial, has been difficult because Interlake's major facilities essential to the production of pulp are old and obsolete. Nevertheless, our mill has managed to continue in operation through a time when other mills using the same pulping process have been closing one by one at an accelerating rate. We know only too well that the cost of pollution abatement facilities has been an important factor in each closing. In some instances the sulfite mills are replaced with facilities for producing kraft pulp, but such a move is not feasible in our Appleton location. We must conclude that it would not be good business judgment to plan additional major capital expenditures to meet further escalated targets in the reduction of BOD loadings at the Interlake mill.

We recognize further reduction in BOD loadings may be necessary to reach the water quality standards proposed for the industrial and cooling water classification. Further reduction by our Appleton mill must come through treatment of the very dilute wastes and at the moment this presents an unsolved problem. Presently, we are conducting pilot studies in our mill on the reverse osmosis or industrial kidney process which is under development by the Pulp Manufacturers' Research League. This will be followed by a large-scale demonstration of a commercial-size unit to be built with funds supported in part by the Federal Water Pollution Control Administration under a research and demonstration grant made to the Research League. The process appears too costly for general application, but we hope it may prove practical for the concentration of certain wastes so as to make more intensive use of our existing facilities.

It has also been suggested that reductions in BOD can be accomplished through the formation of a metropolitan water treatment district with facilities for joint secondary treatment. We believe that this should be given careful study by a planning agency qualified to do the job. Secondary treatment or its equivalent on all industrial wastes on the Lower Fox may be necessary but it appears thoroughly impractical, both technologically and economically, on an individual basis. We submit that any further effort should be directed toward a facility designed for joint treatment of municipal and industrial waste.

Furthermore, we suggest that any such project study be expanded to include an overall study of the hydrology and water quality of the entire Lower Fox. We must have a sufficiently accurate analysis of the whole situation to assure sound forward planning of capital needs. Computer technology now makes such analysis feasible through simulation models of hydrology and water quality. We believe such a study is essential to meet the long-range objectives proposed by the Department of Natural Resources.

In summary, we are proud of what we have done at Consolidated's Interlake mill. We have consistently met the targets set for BOD reduction. We have gone ahead with substantial installations on our own initiative several times when we were already in full compliance with the orders of the Division of Resource Development or its predecessor agency.

STATEMENT OF GREEN BAY PACKAGING, INC.
TO THE DEPARTMENT OF NATURAL RESOURCES,
DIVISION OF RESOURCE DEVELOPMENT

Green Bay Packaging, Inc. operates a neutral sulfite semichemical pulp and paperboard mill in the City of Green Bay, withdrawing water for processing from the Fox River and discharging the water after use. This mill operation is presently under Order 3-57J38AA issued by the Committee on Water Pollution July 27, 1965 to reduce the quantity of 5 day Biochemical Oxygen Demand by 75 per cent to 22,682 pounds per day.

At the time that the Committee first issued an order to the Company in 1957, no technically feasible method of accomplishing this goal was known which would permit the mill to continue its operation. Green Bay Packaging consequently was compelled to seek time extensions to investigate developing

Technology. Meanwhile our Company supported laboratory development work on what appeared to be the most promising process to accomplish our particular needs. We then proposed to the Committee a plan for expanded pilot plant work, which provided for the design and construction of the first pilot scale project of the Atomized Suspension Technique as applied to pulping liquor combustion. After approval by the State, we constructed and operated this pilot plant. This experience dramatically demonstrated a risk that our industry has repeatedly faced at great expense, namely that laboratory success does not necessarily mean practical large scale success. Our pilot plant encountered massive corrosion difficulties that were impossible to overcome. We were compelled to scrap the entire plant as well as the immediate possibility of meeting the Committee order by use of this method.

Following this experience, Green Bay Packaging continued its program of evaluating, in detail, every process that appeared to offer an answer to the problem. We also became the first semichemical pulp producer to join the Pulp Manufacturers Research League to review the potential applications of their

RICHARD BILLINGS

work to our needs.

The League at that time was considering the installation of a commercial-scale Electrodialysis pilot plant and this seemed applicable to our particular problem. We assigned a chemical engineer to work full time on this project with the League technical staff at their laboratories in Appleton. Results eventually forced the conclusion that Electrodialysis, at this stage of development could not be fitted to our process conditions.

Our technical staff continued its evaluation of other developing methods. In 1963 application of the fluid bed combustion process to neutral sulfite semichemical pulping liquors had been reported. We undertook pilot plant work to learn in detail the effects the use of this process would have to reduce BOD and how it could be technically adapted to the process requirements of our mill. Analysis of the pilot plant results indicated that fluid-bed combustion could do the job, and with the State's approval Green Bay Packaging in 1965 contracted for the design and construction of its present fluid-bed combustion plant. This plant was started up in July of 1966 and as is often the case with a new process, encountered a series of process design problems. We established reliable process control during the second quarter of 1967. Operational experience as well as equipment and process improvements are continuing to improve stability.

To keep close watch on how well the new plant can do its job, we expanded our effluent sampling program during 1967. We first increased sampling to a weekly 72 hour composite sample. Then last December, we again expanded the sampling to composite 10 samples each hour 24 hours per day, 5 days per week. The data obtained in 1967 is summarized in the attached table and reflects the effect of the fluid-bed combustion plant. The plant eliminated the discharge of more than twenty three million pounds of pulping liquor solids representing approximately six million pounds of BOD during the year.

The present plant is the first of its design, and as such, required months of process analysis and modification work. Variability of BOD results reflect the many interruptions required for process adjustments or equipment modifications that could not be made without temporary shutdowns. This phase of development is nearing completion, and we expect to eliminate the need for such downtime, except for unexpected mechanical breakdown. As the fluid-bed installation achieves this condition, we are confident that the improved plant reliability, expanded liquor and product storage, and further experience, will enable us to meet the ordered value consistently during 1968.

This progress in eliminating the effects of collectible liquors has been substantial and very expensive. Difficult as it has been, it represents the most simply solved part of the total effluent problem because we have dealt with relatively concentrated BOD contributing materials. We hope to achieve further significant reductions in the effluent BOD. At this time however, no practical method is known to us by which we can separate the undesirable organics from the tremendous volumes of recycled process water in which they are dissolved. Means to accomplish this separation are being studied in the League laboratories and Green Bay Packaging is a participant in the League's large scale Reverse Osmosis project to demonstrate the practicality of such studies. Another possibility now in the preliminary stage of investigation is to send these dilute waters to a bio-oxidation plant capable of processing such weak wastes along with municipal sewage. Green Bay Packaging is actively participating along with other major pulp and paper mills, the Green Bay Metropolitan Sewage District, and the Federal Water Pollution Control Administration to demonstrate the technical and economic feasibility of this approach. These are long term development projects however, and the reliable data needed, assuming a successful completion of either or both projects is not expected until 1970 or 1971.

These methods to remove additional BOD already show evidence that they will be more costly to remove each pound of BOD than the methods we have used to date. Whether such costs are supportable is a question that will not be resolved until these projects or others like them are fully investigated. Planning, when it can be based on factual information will require logical and clearly defined goals. The substantial increase in cost to achieve each new improvement will simply not permit errors in decisions. Large capital expenditures and major increases in operating costs that produce no marketable product will not allow a company to continue to provide employment and strength to its community.

Green Bay Packaging, Inc. has demonstrated a substantial effort. We have achieved significant results in the elimination of pollutional effects of our collectible pulping liquors. We will continue such efforts in attacking the as yet unanswered problems of dilute wastes. We remind the Division of Resource Development that this area of the problem will yield only to new methods. It will take determination, time and expense to identify, develop and put such new methods to commercial use.

Green Bay Packaging will actively continue its present program and its forward progress in accord with both the letter and the spirit of the State's stream protection program.

Respectfully submitted,

William R. Nelson
Director, Research & Development
Green Bay Packaging, Inc.

WRN:kh

1/18/68

GREEN BAY PACKAGING, INC.
STREAM IMPROVEMENT DEVELOPMENT REPORT - 1967

Month	Pulp Mill Op.Days	Fluo Solids Op.Days	%F.S. Oper. Time	#/Mo.BLS To Fluo Solids	%BLS Burned	Average #/BOD/24Hrs. Produced	Effluent Average #BOD/24Hrs.	Average% Reduction BOD	#/M Gals. Filterable Solids
JAN	30	18.0	60	2,469,411	43	79,200	25,926	67	1.35
FEB	28	15.0	54	2,095,787	51	78,700	29,010	63	1.84
MAR	30	13.0	43	3,202,136	50	81,900	42,879	48	2.26
APR	30	15.0	50	3,129,875	49	87,300	39,830	54	2.68
MAY	30	25.0	83	2,597,726	83	78,700	28,449	64	2.20
JUNE	30	29.0	97	2,682,086	96	76,000	18,031	76	0.94
JULY	25	19.0	76	2,040,553	61	75,550	25,561	66	1.13
AUG	28	25.0	89	2,626,199	60	78,700	25,767	67	1.61
SEPT	27	19.0	71	2,561,093	86	78,250	42,574	46	2.41
OCT	31	26.7	86	3,090,125	85	82,500	27,600	66	0.95
NOV	30	20.55	69	2,832,582	63	85,000	31,072	64	1.82
DEC	26.8	20.30	76	2,962,400	94	80,300	27,120	66	1.48

RICHARD BILLINGS

STATEMENT

by

ROBERT F. BALCH

Hearing in Appleton, Wisconsin

State Division of Resource Development

January 18, 1968

My name is Robert F. Balch. I am a Research Associate and Group Leader of the Aquatic Biology Group at The Institute of Paper Chemistry, Appleton, a graduate school and research center.

I have a Bachelor Degree and Master of Science Degree from Michigan State University in Aquatic Biology, and have been employed as an Aquatic Biologist by the Institute for 17 years.

I have been engaged in biological water quality studies in the Lower Fox River and Green Bay since 1955. It is noteworthy that the 1955 Fox River-Green Bay biological water quality study, which forms in large part, the baseline with which recent studies are compared, was a joint effort with Kenneth M. Mackenthun, then state public health biologist, and myself.

RICHARD BILLINGS

I have personally conducted, or supervised, six biological water quality studies of the Lower Fox River and Green Bay. These have been made at regular intervals between 1955 and 1967 on behalf of a group of Fox River Valley pulp and paper companies.

My immediate reason for appearing at this hearing is to provide additional data that may be helpful to aquatic biologists from the State Division of Resource Development in review of their conclusions drawn in the biological portion of their water quality study dated January 4, 1968 and entitled, "Report on an Investigation of the Pollution in the Lower Fox River and Green Bay made during 1966 and 1967".

This group of Fox Valley pulp and paper mills has authorized the Institute of Paper Chemistry to make the data available to State personnel for their use and I discussed the data with the State biologist this last Tuesday.

On Page 14 of the State Report the condition of the biological complex existing in that portion of the river in the vicinity of Appleton Palisades-Appleton Yacht Club is described as containing "no clean water organisms." On Page 17 and 47 of the above mentioned report, the author interprets this condition to indicate a deterioration of water quality in this section of the river since intolerant or sensitive ("clean water") animals were present in this area in 1955 and not apparently, in 1966.

The data reported by the State biologists support their conclusion. However, since the 1955 study, my studies of 1957, 1959, 1961, 1964, and 1967 have all shown the presence of a significant number of several different kinds of intolerant or sensitive organisms to be present in the Appleton Palisades-Appleton Yacht Club portion of the Lower Fox River.

Further, the Division of Resource Development report states that a total of 67 bottom samples distributed over 23 Fox River Stations were the basis for their 1966 biological study of the Fox River. The Institute's 1967 study included a total of 302 samples from 43 Lower Fox River stations including 27 samples which were from the Appleton Palisades-Appleton Yacht Club area alone. In addition, five other studies, all indicating the presence of an intolerant or sensitive animal population in this area, have been made.

It is evident from an inspection of

available data that these sensitive organisms were present on the bottom of the river during six studies including those made in 1964 and 1967. It is probable that additional samples collected by the State biologist would have established their presence there in 1966.

There is no question that the density and diversity of this intolerant or sensitive bottom-dwelling invertebrate animal population in the Appleton Palisades-Appleton Yacht Club portion of the river are reduced as compared to that population present upstream from municipal and industrial discharges, in areas of comparable hydrology, in the Neenah and Menasha channels. There also can be no question that an established resident population of intolerant organisms also has been present in the Appleton Palisades-Appleton Yacht Club portion of the Lower Fox River on at least six different occasions between 1955 and 1967.

In addition to the differences between the 1966-1967 State report and my reports, noted for that section of the Fox River immediately upstream from Appleton, there are some differences regarding the State's finding pertaining to that section of the Lower Fox River between the College Avenue Bridge and the Kimberly Dam, downstream from the City of Appleton.

On Pages 14 and 15 of the State Report, conditions of the biological complex in this area are reported. A comparison of their 1966 data with mine for 1967 indicates a difference in the water quality between these two reports. The additional data presented here indicate that the water quality of that section of the river between College Avenue Bridge and the Kimberly Dam has not deteriorated as described in the State Report.

Appended to this statement is a summary of the data that we have assembled in our most recent survey, along with a list of the companies that have underwritten the costs of this work.

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Biological Study of the Fox River and Green Bay

Project 1861

List of Sponsoring Companies

1.	American Can Company	Neenah, Wisconsin
2.	Bergstrom Paper Company	Neenah, Wisconsin
3.	The Charmin Paper Products Co. (The Procter & Gamble Company)	Green Bay, Wisconsin Cincinnati, Ohio
4.	Combined Paper Mills, Inc.	Combined Locks, Wisconsin
5.	Consolidated Papers, Inc.	Wisconsin Rapids, Wisconsin
6.	Fox River Paper Corporation	Appleton, Wisconsin
7.	Gilbert Paper Company	Menasha, Wisconsin
8.	Green Bay Packaging Inc.	Green Bay, Wisconsin
9.	Kimberly-Clark Corporation	Neenah, Wisconsin
10.	Nicolet Paper Company	West DePere, Wisconsin
11.	Riverside Paper Corporation	Appleton, Wisconsin
12.	John Strange Paper Co.	Menasha, Wisconsin
13.	Thilmany Pulp & Paper Company	Kaukauna, Wisconsin

LOWER FOX RIVER STUDIES – 1967

A Summary of Data Pertaining to the Macroscopic Bottom-Dwelling Invertebrate Fauna

Station Number	Station Mileage	Station Description	Number of Genera			Average Number of Organisms per Square Foot			% Intolerant Genera	Stream Classification
			Intolerant	Tolerant	Very Tolerant	Intolerant	Tolerant	Very Tolerant		
A	40-41.5	Vicinity of Neenah, Menasha channels in Lake Winnebago	1	9	10	5	857	316	5	Semipolluted
1	39.5	Neenah channel – vicinity Neenah light	9	15	9	-[a]	-[a]	-[a]	27	Balanced
2	38.5	Menasha channel upstream from drawbridge	7	11	7	-[a]	-[a]	-[a]	28	Balanced
3	37.9	Little Lake Butte des Morts – downstream from Neenah channel	8	11	9	-[a]	-[a]	-[a]	29	Unbalanced
5A	37.6	Little Lake Butte des Morts – extreme south end	0	1	3	-[a]	-[a]	-[a]	0	Semipolluted
5B	37.3	Little Lake Butte des Morts – power transmission towers	3	6	5	-[a]	-[a]	-[a]	21	East shore – unbalanced, Center of lake & west shore – semipolluted
5C	37.0	Little Lake Butte des Morts – midway between K.C. Lakeview and C.&N.W. rail trestle	2[b]	3[b]	5[b]	-	9	28	20[b]	West shore – polluted, East shore & midlake – semipolluted
5D	36.9	Little Lake Butte des Morts – vicinity C.&N.W. rail trestle	1[b]	4[b]	4[b]	0	3	24	11	West shore & midlake – polluted East shore – semipolluted
5E	36.6	Little Lake Butte des Morts – midlake	1[c]	1[c]	0[c]	-[a]	-[a]	-[a]	50[c]	Semipolluted
5F	36.2	Little Lake Butte des Morts – midway between C.&N.W. rail trestle & Stroebe's Island	0[b]	3[b]	2[b]	0	9	9	0	Polluted
6	35.5	Little Lake Butte des Morts – south end of Stroebe's Island	0	4	5	0	68	219	0	Semipolluted
6A	35.2	Little Lake Butte des Morts – power transmission lines – Stroebe's Island	0	2	4	0	4	48	0	Semipolluted
6B	35.0	Little Lake Butte des Morts – Stroebe's Island – north end	0	3	7	0	9	44	0	Semipolluted
7	34.5	Little Lake Butte des Morts to Fox River transition zone	1[b]	10[b]	7[b]	0	5	140	0	Gray board house vicinity – semi-polluted, downstream gray board house – semipolluted

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[a] No quantitative samples.

[b] Combined qualitative and quantitative data.

[c] Sample data questionable.

LOWER FOX RIVER STUDIES – 1967

A Summary of Data Pertaining to the Macroscopic Bottom-Dwelling Invertebrate Fauna

Station Number	Station Mileage	Station Description	Number of Genera			Average Number of Organisms per Square Foot			% Intolerant Genera	Stream Classification
			Intolerant	Tolerant	Very Tolerant	Intolerant	Tolerant	Very Tolerant		
8	32.8	Appleton – Palisades to Lutz Park	10	17	11	-[a]	-[a]	-[a]	26	Unbalanced
9	30.5	Appleton – College Avenue Bridge –	5	15	8	-[a]	-[a]	-[a]	13	Unbalanced (right bank) Semipolluted (left bank)
10	30.0	1/2-Mile downstream – College Avenue Bridge	0	11	9	-[a]	-[a]	-[a]	0	Semipolluted (left bank)
11	28.5	Vicinity of the Appleton Sewage Treatment Plant	0[b]	14[b]	9[b]	0	422	26	0	Left bank & midstream – semipolluted Right bank (100-yd. downstream from sewage outfall) – semipolluted
13	27.8	Sunset Point – Kimberly	1	14	12	-[a]	-[a]	-[a]	3	Semipolluted
14	27.3	Kimberly Dam – immediately upstream	0[b]	10[b]	11[b]	0	2228	206	0	Semipolluted
16	26.4	Vicinity Riverside Sanitarium, shortly downstream from Combined Locks	0	10	8	-[a]	-[a]	-[a]	0	Right bank – polluted Left bank – semipolluted
16A	25.0	Midway between Riverside Sanitarium and Riverside Park – Kaukauna	0	7	11	-[a]	-[a]	-[a]	0	Semipolluted (left bank) Polluted (right bank)
17	24.3	Riverside Park – Kaukauna	0[b]	6[b]	9[b]	0	64	32	0	Polluted
18	23.2	1.5-Miles downstream – Kaukauna	0	3	2	0	220	20	0	Polluted
19	22.5	Midway between Kaukauna & Rapide Croche	0[b]	2[b]	3[b]	0	1	3	0	Polluted
20	20.0	Immediately upstream – Rapide Croche Dam	0[b]	5[b]	4[b]	0	17	5	0	Polluted
21	18.5	Midway between Rapide Croche & Wrightstown	0	7	6	-[a]	-[a]	-[a]	0	Polluted
22	16.0	1 Mile downstream – Wrightstown	0	5	4	-[a]	-[a]	-[a]	0	Polluted
22A	14.2	Midway between Wrightstown & Little Rapids	0	2	1	0	14	9	0	Polluted

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[a] No quantitative samples.

[b] Combined qualitative and quantitative data.

LOWER FOX RIVER STUDIES - 1967

A Summary of Data Pertaining to the Macroscopic Bottom-Dwelling Invertebrate Fauna

			No. of Genera			Average Number of Organisms per Square Foot				
Station No.	Station Mileage	Station Description	Intolerant	Tolerant	Very Tolerant	Intolerant	Tolerant	Very Tolerant	% Intolerant Genera	Stream Classification
23	12.1	Immediately upstream - Little Rapids Dam	0	2	3	0	7	7	0	Polluted
24	11.9	Shortly downstream - Little Rapids Dam	1[c]	5	6	--[a]	--[a]	--[a]	8	Polluted
24A	11.5	Opposite Hickory Grove Sanitarium	0	4	5	0	25	59	0	Polluted
24B	10.7	Midway between Little Rapids and Hickory Grove Sanitarium	0	3	3	--[a]	--[a]	--[a]	0	Polluted
24C	9.7	2.3 Miles downstream from Little Rapids Dam	0	2	2	0	9	25	0	Polluted
24D	9.2	Junction of Lost Dauphin Road and County Highway D	0	1	3	0	4	26	0	Polluted
25	8.7	De Pere radio towers	0[b]	2[b]	5[b]	0	23	54	0	Polluted
25A	7.0	St. Norbert College Campus	0	3	5	0	28	79	0	Polluted
26A	6.4	Immediately downstream De Pere Dam	0	7	8	--[a]	--[a]	--[a]	0	Semipolluted
26B	6.0	Downstream De Pere Dam 3/8 mile	0	1	1	0	<1	9	0	Polluted
26C	5.2	Ashwaubenon Creek Slough - Buoy 19, 20	0	0	1	0	0	3	0	Polluted
26E	4.3	Dutchman's Creek Slough	0	0	0	0	0	<1	0	Left bank - polluted, midstream & right bank - polluted
26G	3.1	Opposite Ft. Howard Paper Co.	0	0	2	0	0	24	0	Polluted
27E	0.8	City of Green Bay - near mouth of East River	0	3	1	0	19	50	0	Polluted
27F	0.0	City of Green Bay - mouth of Fox River at power plant	0	3	4	0	22	<14	0	Polluted

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[a] No quantitative samples.
[b] Combined qualitative and quantitative data.
[c] Questionable sample.

RICHARD BILLINGS

STATEMENT OF R. M. BILLINGS
ASSISTANT TO THE VICE PRESIDENT
RESEARCH AND ENGINEERING
KIMBERLY-CLARK CORPORATION

RE: THE INVESTIGATION OF POLLUTION
OF THE LOWER FOX RIVER

TO: DEPARTMENT OF NATURAL RESOURCES
DIVISION OF RESOURCE DEVELOPMENT

APPLETON, WISCONSIN
January 18, 1968

My name is Richard Billings. I am assistant to the Vice President of Research and Engineering of Kimberly-Clark Corporation. I am appearing before you today to outline briefly the stream improvement programs now in various stages of planning and completion at the Kimberly-Clark mills situated on the Fox River. As these additions and changes are accomplished, pollution from these mills will be progressively reduced. This will be an important contribution to the total effort being made throughout our Valley -- a total effort designed to significantly improve the Fox River.

The effect of these improvements should be felt this coming summer, and will become increasingly apparent in the following years. It will take time, however, to bring the Lower Fox into year around compliance with the standards recommended by the Division of Resource Development. Pulp and paper has been manufactured in our Fox Valley for nearly a hundred years.

The majority of the mills are old mills and pollution reduction is much more difficult to achieve with old mills than with new ones. Today concern for pollution abatement has become increasingly widespread. Advanced abatement methods can now be incorporated in the design of a new plant from the very beginning. This was not true when many of the Valley's existing mills were built. Because it was not, we are faced with the problem today of painstakingly working out individual solutions for each old plant. These solutions must be tailormade to the physical layout and location of a plant, to the plant's technological development and to the economic climate in which it exists. Sometimes a practical solution cannot be found and the operation must be discontinued. Whatever the solution may be, it does not come easily or quickly.

Further, it has been demonstrated that it requires at least three years to conceive and develop a program from the laboratory until, having passed through the pilot plant, full-scale design, construction and shake-down stages, it emerges as an operating unit. Even after operations start, a period of months must elapse before the "bugs" are all eliminated and the new system is brought up to design efficiency. The treatment facilities already in operation and the increasing frequency of start-up of new ones, bear testimony to the fact that the paper industry has long been hard at work to meet today's demands for improved streams.

But just as today's improvements are the results of yesterday's preparations, so today we must plan for tomorrow -- and each tomorrow with its increase in population and production will likewise increase the challenge. Installations which we make today must be flexible and adaptable and expandable. We cannot afford to spend huge sums on equipment which will do the job now but which, before long, will have to be abandoned because of obsolescence. We who have the assignment of improving our streams through reducing pollution must look carefully down each street -- every street -- to see that it does not come to a dead end. And the streets are not marked!

One avenue that appears at this time to hold much promise is the one which leads to joint treatment of industrial and municipal wastes. Pollution is everybody's problem and today's conditions are due to population growth as well as to industrial expansion. No plan for the future of an area can ever be complete unless it includes practical provision for waste disposal. The Fox Valley Council of Governments is launching such a study -- the first of its kind in the area. Engineers have been engaged and a comprehensive review of present and future municipal and industrial requirements will be undertaken. Local funds have been approved, application for a Federal grant has been made and approval is expected shortly.

First, however, there is much to be done and much is being done at individual mills to solve the problems of today. Each solution will be made with an eye to the future. For no matter what the Council of Governments study reveals, or what breakthroughs are made by research, or what reductions in pollution are accomplished by industries and municipalities, that which we do today must be considered only as the step that precedes the steps which come tomorrow and in the future.

Pollution Abatement at Kimberly

The Kimberly mill has been reducing the spent sulfite liquor pollution of the Fox River since 1949. Progress has been steady, but because the sulfite pulping operation at Kimberly is over seventy-five years old and the mill is an old one, progress has been made one step at a time. First was a reduction of 40 per cent, later this was increased to 50 per cent, then to 70 per cent for the seven months of the year when warm water and low flow give rise to the most critical pollution problems, then to 70 per cent the year around, and today the oxygen demanding load which each gallon of the river is expected to assimilate is 75 per cent less than it was during the period of August 1 to

November 30, 1948, used by the State as a basis for comparison.

These reductions were brought about by attacking the problem from several angles. The actual amount of sulfite pulp produced has been cut back until today normal operation is 40 per cent less than it was in the summer of 1948. Huge storage ponds holding a total of 30 million gallons of spent liquor were constructed so that the abatement target could be maintained during every day of the year. These ponds, by providing temporary storage during low flow, prevented overload of the river at any time. A roadbinder program was instituted at considerable cost and millions of gallons of the concentrated spent liquor were disposed of on country roads to lay the dust and reduce the maintenance.

In spite of this progress, it became evident over two years ago that conditions in the river were still not good enough to insure the presence of dissolved oxygen at all times in the Lower Fox during all hot days of summer. At a meeting held with the Committee on Water Pollution in December of 1965, Kimberly-Clark agreed to study the possibility of substituting some other pulping process giving less pollution than the sulfite process. Kimberly-Clark further stated that if the change to another process did not prove feasible and no other suitable method of further reducing pollution could be found during this time, the corporation would discontinue sulfite pulping operations at Kimberly at the end of two years. Activity has been intense. Pilot plant production of trial pulps and mill scale trials of purchased pulp have been made. The economic possibilities of various pulping processes have been investigated. The feasibility of converting the old sulfite mill has been the subject of engineering study. Alternatives have been weighed.

By last winter it had become apparent that no alternate method of pulping would utilize the existing equipment and satisfy the other requirements for a mill situated as Kimberly is and producing the types of paper that Kimberly does. No new research development had appeared that could be immediately applied to the Kimberly problem. If pollution were to be further and significantly abated, the only solution available was to cease operation of the sulfite mill entirely.

This is not the answer we wanted. The

elimination of many jobs will affect the economy of the Village and the reduction in purchases of pulpwood, power, finishing supplies and maintenance materials will affect a much greater area. The cost is high to Kimberly-Clark also. The existing system pumps wet pulp directly from the cooking area to the paper machines, thus eliminating the costly drying and repulping steps. Conversion to purchased pulp required that equipment be purchased and installed for unloading dry baled pulp, conveying it to and from storage and then repulping it to the water suspension required for use in paper manufacture. This new equipment has cost the Kimberly mill $192,000.

Sooner or later the sulfite mill would have been shut down anyway because old equipment becomes steadily more obsolete and difficult to maintain. Four of our six digesters, however, would be all that would be necessary to maintain our present 80 tons per day production schedule and would have made it possible for us to continue operations for from five to seven years longer. We would have preferred to keep the pulp mill in operation as long as possible because even at present pulp prices, it will cost us $300,000 more a year to operate the Kimberly mill on dry pulp purchased from elsewhere than on wet pulp manufactured at Kimberly. Also, the next five to seven years of the intensive research effort going on nationally into ways of abating pollution, might turn up a method that would be applicable to the Kimberly problem. So, I repeat, shutdown is not the answer we wanted, but it is the only one we could find if pollution from Kimberly were to be further significantly reduced at once.

The phasing out of the operation is going along on schedule. Installation of new equipment is complete. Trial runs are about to start. To lessen the impact of the shutdown on the employment and economy of the Village, plans were made months ago. The timing has been set to take full advantage of the summer vacation period and of the attrition normally expected. Nevertheless, over fifty people who have been hired during the last two years will be laid off and others will take poorer paying jobs. Entirely aside from the economic aspects, the impact of demotion upon the individual is severe.

In spite of these and other problems we will meet our promised deadline of May 31st. From that date on we expect to hold the Biochemical Demand of discharges from the Kimberly mill to less than 10 tons of oxygen per day, and we are already partially compensating for this by the several tons of oxygen which we add by turbine aeration during the critical summer months.

Work is in progress on reducing settleable solids in the mill waste waters. Discontinuing sulfite production will reduce woodroom losses and eliminate the discharge of fibers and fines resulting from sulfite cooking and bleaching. More efficient internal handling of waste streams and the separation of flows of relatively clear water which require no treatment will be possible. New water and waste balances will be undertaken for the mill as soon as operations have settled down after the changeover to purchased pulp in June.

We believe that the primary philosophy of pollution abatement should be one of maximum recovery, thus requiring a minimum of ultimate disposal. One of the more difficult wastes to reclaim and to reuse in papermaking is the waste water from the coating process. Very promising progress is being made in the Kimberly-Clark Research and Engineering Department at Neenah, Wisconsin, on a separate treatment for this waste stream. If the laboratory tests are borne out, a major obstacle to the reduction of paper mill pollution will have been removed. The process would make possible the removal and recovery of large amounts of clay and would reduce the dispersing power of the starch and protein binders. This reduction in dispersing power of the coating wastes would, in turn, improve the efficiency of any final settling process used on paper mill effluents. This new process thus may reduce pollution in two ways.

Laboratory tests are being substantiated in a bench scale pilot plant now. If these tests are successful, a continuous pilot plant will be constructed at the Kimberly mill. It will take about eighteen months to complete the pilot plant studies. In the meantime, wastes stream separation, recirculation and disposal needs will have been determined by mill personnel and the results of the two programs will be combined to establish the size and nature of treatment facilities required. The Fox Valley Council of Governments survey will be completed by that time and the decision will then be made as to whether the Kimberly mill becomes a part of a Fox Valley project, or installs treatment facilities of its own.

Our recommended timetable would be as follows:

May 31, 1968 - Close down the Kimberly sulfite pulp mill

Dec. 31, 1969 - Submit outline to DRD as to proposal for treatment facilities either:

a) As a joint venture

b) As separate treatment at the Kimberly mill

If a joint venture, the Kimberly mill will, of course, expect to meet the joint schedule.

If separate treatment at the Kimberly mill is decided upon, the timetable would continue as follows:

March 1, 1970 - Submit detailed plans to DRD

One year after DRD approval - construction to be completed and facilities placed in operation.

Pollution Abatement at the Neenah Mills

LAKEVIEW

The new clarifier at the Lakeview mill will begin operation this spring. Shipment of the last of the equipment will be made within the next few weeks. The clarifier climaxes a program of stream improvement that has extended over a period of ten years. In 1964, a disc filter was installed to remove fibrous material from the waste stream passing to Little Lake Butte des Morts. This installation reduced the losses to the lake by 28 per cent. The material so recovered is returned to the process, the greater portion thus becoming usable again. This is the hope and goal of most in-plant recovery processes.

The cost of the clarifier now being installed at Lakeview is an entirely different matter. The sludge separated has no use and must be removed. To date, therefore, no way has been found of returning a penny of the quarter of a million dollars spent in the clarifier installation. In addition, it will add materially to the annual operating costs of the Lakeview mill. Interest on the investment, clarifier operation and sludge disposal costs are expected to approach $50,000 per year. For as long as that mill continues to exist, a great many additional boxes of Kleenex tissues will have to be sold to pay for the clarifier and its operation.

It was decided to install the clarifier after nearly four years of investigation of various methods of reducing pollution to Little Lake Butte des Morts.

This installation reduced the losses to the lake by 28 per cent. The material so recovered is returned to the process, the greater portion thus becoming usable again. This is the hope and goal of most in-plant recovery processes.

The cost of the clarifier now being installed at Lakeview is an entirely different matter. The sludge separated has no use and must be removed. To date, therefore, no way has been found of returning a penny of the quarter of a million dollars spent in the clarifier installation. In addition, it will add materially to the annual operating costs of the Lakeview mill. Interest on the investment, clarifier operation and sludge disposal costs are expected to approach $50,000 per year. For as long as that mill continues to exist, a great many additional boxes of Kleenex tissues will have to be sold to pay for the clarifier and its operation.

It was decided to install the clarifier after nearly four years of investigation of various methods of reducing pollution to Little Lake Butte des Morts. No further in-plant methods such as the disc filter or added recirculation and use of water were found that were adaptable. Tests involving lagooning at first appeared promising. Over a two-year period, however this method proved to be unsatisfactory in the limited areas available, due to the unpredictable occurrence and length of Wisconsin's wet and dry spells.

When operation of the clarifier has settled down, we expect that the Biochemical Demand of discharge to the river will be less than three-quarters of a ton of oxygen per day, and over 90 per cent of the settleable solids will be eliminated.

BADGER GLOBE MILL

This mill located in the center of Neenah has maintained its discharge to the river at less than 1 lb. fiber/1000 gal. of effluent for over fifteen years and at the same time has maintained, or in some years actually decreased, the total gallons discharged to the river. Formerly a four-machine mill, two machines have been shut down in the last four years. These were the oldest in Kimberly-Clark and therefore were unable to meet the competitive demands of today. They also had the very high losses of fiber that characterize old machines, so their shutdown further reduced the total fiber loss from the mill. During this same period, separation has been made of waste waters in which fiber concentrations are high, and these go to the sanitary sewer while the dilute waters go to the river. A new vacuum save-all designed to recover fiber is performing efficiently.

Recent installations of new diversion gates and semi-automatic control are assuring that present control limits of less than 1 lb/1000 gal. suspended material in the effluent will continue to be maintained. BOD from the mill is less than 400 lbs/day.

Pollution Abatement at the Neenah Paper Company

When this mill was purchased by Kimberly-Clark in 1956, it was over 80 years old. Discharges of waste-containing waters at that time emptied into the river through one hundred and fifty-three different pipes, and total losses could only be roughly estimated. Since then we have gradually been modernizing equipment and in the process we have been working out a comprehensive effluent control system in which the discharge points have been reduced from 153 to four. The first complete survey of the mill losses by Kimberly-Clark indicated a daily solids loss to the river of 3,135 lbs. and BOD in excess of 2000 lbs. Since that time, in spite of increased production, the total loss to the river per operating day has been reduced to an average of less than 1000 lbs. of fiber and 300 lbs. BOD. This has been accomplished chiefly by in-plant additions of two filtration and one flotation save-alls, and by the rerouting of pipelines to reuse water. As at the Lakeview mill, we see no further in-plant improvements to be made at this time. Study is underway of the problems involved in collecting, at a single point, the four process water discharges mentioned about and of installating facilities so that this water may be screened before it passes to the river. This step will eliminate the chief source of pollution still remaining from the Neenah Paper Company plant; namely, fiber losses occurring when grades are being changed or when the mill is being shut down. It should be pointed out that the fibers removed by the screen will not be suitable for reuse, and so must be disposed of otherwise. The screening system at Neenah Paper Company, therefore, like the

Lakeview clarifier, is strictly an added cost of doing business.

A pilot plant screen unit is now testing the proposed process, and several months will be required to determine its effectiveness and any operating problems. If this proves as successful as we are confident that it will, engineering of a full scale collection and screening unit will be completed and plans submitted to the DRD by December 31, 1968. Installation should be complete nine months after DRD approval is received.

This has been a brief background of the accomplishments that have been made, of the problems that are still confronting us, of the steps that are in progress to correct these problems and a timetable for the completion of these steps.

STATEMENT FOR LOWER FOX RIVER

D.N.R. HEARINGS - APPLETON

JANUARY 18, 1968

Mr. Chairman, Members of the Natural Resources Board, Fellow Citizens:

My name is Robert E. Driessen. I represent

Thilmany Pulp & Paper Company, an integrated kraft pulp and paper mill located at Kaukauna, Wisconsin. I am Technical Assistant to the Vice President-Manufacturing and my primary responsibility is the company's stream improvement program. For the past 25 years, I have been a Registered Professional Engineer in the State of Wisconsin.

Thilmany Pulp & Paper Company, established in 1883, considers itself fortunate in being situated in the Fox River Valley and in being able to play a significant role in its growth. Presently 1,600 individuals pool their daily efforts to produce 800 tons of kraft pulp and paper, acquiring the income to participate in the highly regarded community life of the Valley.

Thilmany uses less than 1 per cent of the average daily flow of the Fox. The incoming water is processed through mechanical clarifiers and is chemically treated when used in pulp washing, bleaching, paper manufacturing or for process stream and power generation.

The pulping process is of the kraft type, making it possible to utilize 99 per cent of all of the raw material. The bark must be removed from the logs, but is collected and burned in one of the boilers. Cooking liquor is concentrated by evaporation and burned to recover the chemical. By-products of turpentine and soap skimmings are collected and marketed. Non-usable residual chemicals are accumulated at the source and trucked to company-owned landfill areas.

In the paper mill, each of the eight paper machines is equipped with its own vacuum filtration system to minimize fiber, filler, and color loss. Subsequent to the individual primary filters is the secondary salvage system comprised of a very large disc-type Saveall designed to further minimize the same losses. Ninety per cent of the process water is then channeled to the lagoon sedimentation system where suspended solids are settled and where natural aeration occurs over the 20-acre surface area provided. Incidentally, since 1958, the treatment system has included the effluent from the City of Kaukauna sewage plant. This will terminate during 1968 upon completion of their secondary treatment facilities. Settled solids are removed from lagoons by dredge pumping to a five-acre drying bed, from which the sludge is removed and trucked to landfill area. This comprises the basic system for handling and treating effluent losses.

To show the effectiveness of the system described, I would like to refer to the Department of Natural Resources, Division of Resource Development Report of January 4, 1967, which, in our opinion, substantiates the resulting performances. Referring to Table 2, which covers DO and BOD and coliform count during 1966 and 1967, it is noted that no significant differential exists in dissolved oxygen or BOD at locations on the river immediately above and below Thilmany.

Table 3, which compares DO and BOD during the years 1964, 1965, and 1966 again indicates no significant differences between readings taken above and below Thilmany properties. Table 6, the biological study, appears to confirm the data in Tables 2 and 3, as relatively no change is indicated when data is compared on samples taken above and below Thilmany on July 21, 1966.

Current plans are directed at continued reduction of losses at the source, the elimination of special discharges and the greater reuse of process water resulting in decreased suspended solids and BOD_5 being discharged to the lagoon system. Refinement of techniques is expected to result in further reclamation of by-products. Twenty-nine active projects comprise the present program designed to accomplish these objectives.

Thilmany has just announced the planned addition of a new paper machine with supporting facilities. This will complete the most recent five-year expansion and modernization program as covered in letters to you on December 29, 1967 and May 24, 1965 in accordance with Order No. 3-57J-30 of October 10, 1957. Incorporated in the design of the new machine will be applications of the latest technology for minimizing material loss and for water conservation.

In summary, I would like to state that Thilmany has spent over $3,500,000 in capital improvements directly and indirectly related to elimination of material losses to the river. Operating costs of treatment facilities cost the company approximately $100,000 per year. Budgeted capital expenditures for 1968 total $200,000. Detailed reports covering the above have been supplied to you on a regular basis.

The results attained from the above have been gratifying and concentrated attention will be aimed at increasing the efficiency of the highly regarded existing treatment system.

One final point I would like to make. A vital need exists to coordinate the efforts of the municipalities and industries with all parties involved in the control and use of the waters in the Winnebago watershed. An example is the recent action of the Fox Valley Council of Governments decision to survey the existing facilities and determine the future treatment requirements of a portion of the Valley. The singular goal should be the best use of total dissolved oxygen available and development of the full natural reaeration potential of the entire Winnebago watershed especially during the short, critical summer period.

For example, during 1967, Thilmany monitoring of DO at locations above and below the mill revealed satisfactory conditions until mid-July, at which time the stream flow was reduced by 1/2 and the DO almost immediately decreased from 4 to 1 mg/liter. The above occurred at a time when the lake level was 14" above crest at Menasha Dam, or 32" above the established minimum.

The 265 square miles comprising the Lake Winnebago pool, with 39" of depth legally available for flow control, has capacity for storage of more than 80 days of average flow through the lower Fox. Under existing criteria for control, the daily average flow has fluctuated from 1,000 sec. ft. to 23,000 sec. ft. during the past 10 years, with an average of 3,770 sec. ft. During the critical summer months, the river flow has been 40 per cent below the annual average, contributing sizably to the problems we are discussing here today. Maintaining the Winnebago pool level at maximum elevation until late June and controlling the release of the waters to the lower Fox at a rate of 3,500 to 4,000 sec. ft. would very likely result in sizably improved natural aeration by best use of the 166 ft. drop in elevation from Lake Winnebago to DePere.

It is quite possible that provision of additional water storage, over and beyond that of the Winnebago pool, may be a logical economic solution to ultimate improvement of the waters of the lower Fox.

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MR. STEIN: Thank you, Mr. Billings.

Are there any comments or questions?

MR. KLASSEN: Mr. Chairman, it would be much more pleasant if I sat here and didn't say anything, I know, but if I did, someone might think that I accepted all of these statements, which I know are given in good faith, but honestly, to me this is the old line, the old-fashioned approach.

(Applause.)

"We need more research. We are not ready for a solution." Yet this very speaker detailed all the research and all the study that has been going on for years and years, including their Institute.

Now, I know from my own experience--now, this is not directed towards their industry, but if the shoe fits, put it on--I know from my own experience that very often it is cheaper to study and do research than to get the job done.

Now, I am reminded of what Patrick Henry said, I know you all know this. He said, "They tell us, sir, that we are weak," when we were going to take action to become a Nation. He said, "When will we be strong? After we have been further beaten down by the British?"

I want to make this analogy here. "We are not ready yet, we need more time, we need more research, these timetables are unrealistic. Therefore, we should wait." How long should we wait, until all of Green Bay is gone? I have been up there, and I think that--

Now, I want to agree with the first part of your statement, so far as the State of Wisconsin is concerned they have been one of the leaders, they have had a fine program, they have had many good men, and this is not criticism of the State of Wisconsin.

But I have been up in that Green Bay area. I just wonder how long you want to wait up there? What more research do you need? Now you are going to make it available to us. I thought it was available.

I am not surprised at this, but I am really disappointed in this attitude of industry, because believe me, it is old-fashioned.

MR. BILLINGS: Well, Mr. Klassen, I would suggest that you look fairly clcsely at the exhibits that I entered. You say you have been up to Green Bay. I live there. I don't come up just occasionally. I know what the progress has been in our area. I have been working in this area for a great many years. If I came before you today with no record of accomplishment, with simply the request that we be given more time, then I think your remark would have been justified.

But I would like to point with pride, I think that this meeting would have spent much better time if there had been more pointing with pride and less beating of chests mixed with pumping of chests in this case. We have new installations coming on that river all the time, starting right up at the outlet to Lake Winnebago, installations are going on. It has been a proven fact that it takes about three years' time to take an idea from the laboratory stage through the pilot plant of development, the shakedown stage until it becomes an actual operating entity. We have those, they came on the line last year, the year before, they are coming on right now, right today, and we are not talking about these. This is not an excuse for inactivity.

Whenever you get down near the goal line in a football game, the going becomes much tougher, and that is exactly the case that we find ourselves in now. I could name any one of the industries along the river as to what has been done and the money that has been spent. In fact, I would challenge most of the people that I have heard at this last six days who have gotten up and talked about what needs to be done to ask, how many of you individually have actually done something? This is not talking to the group of Conferees here who are in it all the time, but I am in it all the time myself. We have money to prove that we are putting our pocketbooks where our speech is. We have made investments.

When I talk about the money that has been spent, I refer only to that portion of the iceberg which you can see. I didn't even mention the amount of money that must go into research before any manufacturing process is put on the road. Fully as much time is spent on determining what is to be done with wastes on a new plant as there is on the water supply for that plant.

MR. HOLMER: Clarence, if I might--

MR. BILLINGS: There are certain problems that are really difficult to handle.

MR. HOLMER: Clarence, if I might, I would like to comment on these comments of Mr. Billings.

The concern about delay and the need for more research I think is one that you and I are particularly aware of.

There is one instance in Green Bay where there is a research project, referred to in Mr. Billings' statement, in which we are trying to achieve the joint treatment of municipal and industrial wastes there, including four paper mills. This is a departure from past practice and one that we expect will result in both a dramatic reduction in BOD and in the removal of phosphorus.

The timetable for this project is a very tight one. It has been reviewed very intensely with the Federal Water Pollution Control Administration, and it is my understanding that it is entirely approved by FWPCA. It calls for completion of construction by September 30, 1972. This would not be in conformance with the suggested timetable that is included in the FWPCA Report.

I want the timetables to be as tight as possible too, but this is one where there is needed movement through pilot plant to operating conditions and it does take time.

MR. STEIN: I think we can get to those

specifics.

Maybe I look at this a little differently, but, you know, Dick, Mr. Klassen and some of us sitting here have heard this story from industry a long time. I recognize that you speak for-- what? --about a dozen companies here, and when you speak for a dozen companies you tend to hit the lowest common denominator and the more liberal views don't show. My experience is this monolithic approach of the industry in these joint statements when you deal with the negotiations doesn't show.

We are making advances, just like a glacier, but, Clarence, remember 15 years ago the representatives of the pulp and paper industry said we didn't need any Federal enforcement at all and this should be left to the States and the Federal Government should confine its role to research. Now, they say we have a secondary role with the States; and now what we have to do, although the Conference is premature, is get a little research and be given more time.

I think we are getting closer and closer together. But if it took us 15 years to get this close, I wonder if the quality of Lake Michigan is going to wait or we are not going to ruin the Lake before we get completely close and close enough.

There is one other point you made here on this cost-benefit operation, that we should take in cost-benefit. The pulp and paper industry, and many other industries, have made that plea to the Congress many times. The Congress has considered this. They set up the control measures as we have here.

I am not saying that the cost-benefit approach is not a possible approach. I don't think it is applicable; it should be applicable to water pollution control. Other people evidently have a different view.

But if you have that view, I think you have addressed this to the correct forum, the Congress. Neither the States, or any of the four States, in their legislation have taken the cost-benefit approach as a basis for State legislation, nor do we have it in Federal legislation. And, Mr. Billings, I will defend to the death your right to go to the Congress any time you want to, to get them to change it. But as I understand the four State laws and the Federal law, this is not the approach we use in applying these conditions.

I do think there are certain recommendations made here. If, as you say or Mr. Holmer says, there are specific plants that have to put in treatment works to do this, this is fine. And we will take these up and look at them with particularity.

As I understand this report, though, there is no argument here for treatment for treatment's sake. That is, the treatment has to be related to water quality.

But again as I heard in the last few days, and there is a viewpoint which indicates, I don't know that the Conferees are going to do it, but the viewpoint indicates that unless heroic measures are taken and taken pretty soon to save Lake Michigan, we may be beyond the point of no return.

I wonder if we can afford the indulgence of talking about further research, pilot plants, looking for new processes, and so forth. Are the waters of Lake Michigan going to wait with us?

MR. BILLINGS: Mr. Stein, there is no question in our minds that it can't wait. We are not waiting. You request heroic effort. We are making heroic efforts.

My objection to the arbitrary timetable is in both directions. It isn't going to take three years to do certain things. We have got some good progress right now. But it is going to take more than three years to do certain things because we don't know the answers.

You heard yesterday Mr. Purdy make a statement that the requirement of 80 per cent removal of phosphates had not yet been established but it looked to be the best way to proceed.

One question that was not asked Dr. Bartsch when he was on the stand here that I would think would have been a very excellent question was simply this: If the removal of phosphates as recommended in this report were to be accomplished, would you, Dr. Bartsch, as a technical man say that this would eliminate our algae problem?

Dr. Bartsch--I don't think he is here today.

MR. STEIN: He isn't here today, and the reason he was released was we have our local enforcement man and biologist here, Mr. Cook, who has been associated with Dr. Bartsch on this report and is prepared to answer that question if you want to raise it with him.

MR. BILLINGS: I wouldn't mind asking that question.

MR. STEIN: Mr. Cook, do you want to try to answer that?

MR. COOK: I am Grover Cook, Director of Enforcement, the Great Lakes Region, FWPCA.

I understand the question is that if the phosphorous content of Lake Michigan were reduced substantially there would be an immediate -- or not immediate, perhaps, but there would be a reduction in the development of algae.

MR. BILLINGS: That was not the question.

MR. COOK: Will you restate it, please?

MR. BILLINGS: The question was if the reduction of phosphates in the effluents as recommended were to be established, would we see an end to our algae problem?

MR. COOK: Well, I can say yes and qualify it a bit. This has been done in other places.

In the Madison Lakes, for instance, when the phosphates were stopped from being discharged to the lakes, it no longer became necessary to copper sulfate or treat with arsenic.

We found in Lake Huron, a very careful study done by the Canadians, that when they applied phosphorus to a certain area it grew algae and when they stopped the algae went away.

I don't think there is any doubt about it, with the stopping of the discharge of phosphorus and other nutrients, we will reduce the concentration or the development of algae in the Lake.

MR. STEIN: Thank you.

Dr. Boruff, please.

DR. BORUFF: I would like for the speaker to make a little arithmetic problem.

Realizing the by-products that you have developed from your waste streams, about how much PE is left per ton of paper? I am trying to throw this whole thing into perspective.

MR. BILLINGS: How much what?

DR. BORUFF: How much population equivalent is left after you have taken out by-products, how much is left today?

Then I would like to multiply that by tons of paper to get the entire pollution load in perspective.

MR. BILLINGS: Well, if you are talking

population equivalent in urine and feces, zero.

If you are talking population equivalent in infectious hepatitis, zero.

If you are talking any of the E coliforms--

DR. BORUFF: You are skirting my question. I realize --

MR. BILLINGS: No, you said population equivalent, and I object very strenuously to that term. If you say population equivalent in oxygen demand, then I might try to answer it differently.

DR. BORUFF: Population equivalent to me, sir, is based on BOD, oxygen demand.

MR. BILLINGS: Oxygen demand only.

DR. BORUFF: Okay, we are on the same basis now.

MR. BILLINGS: All right.

DR. BORUFF: How much residual population equivalent or pounds of BOD after you have taken out your by-products is left per ton of paper, about?

MR. BILLINGS: It varies tremendously depending upon the grade of paper made.

For example, it will run from --

DR. BORUFF: Take the average for the State of Wisconsin, which is a Duke's mixture of a number of different processes.

MR. BILLINGS: You can't take an average when ground wood has 10 pounds of BOD and kraft has 60 and sulfite has 600. An average would be relatively meaningless.

Actually, in our sulfite mills they are mostly in the neighborhood of 70 to 85 per cent reduction in BOD. You notice I am skirting population equivalent because I don't like the term, but pounds of biochemical oxygen demand.

DR. BORUFF: All right, you give me that figure and I will divide by 17 hundredths.

MR. BILLINGS: No.

DR. BORUFF: How many pounds -- if you want to go pounds of BOD, then give me pounds of BOD.

MR. BILLINGS: Well, that is what I am saying, that in each case it is a reduction of approximately, oh, I would say a very hard average figure, but from 70 to 80 or 85 per cent reduction of the sulfite, which is about -- untreated it comes close to 600 pounds of BOD per ton produced of pulp.

With paper it is about 20 pounds or less.

But you are talking about BOD here strictly, Dr. Boruff, not phosphates?

DR. BORUFF: I am not talking phosphates at all. I am talking about PE load -- or, excuse me, pounds of BOD.

Eighty per cent removal on a general base of 600 pounds of BOD per ton?

MR. BILLINGS: Well, I think that is --

DR. BORUFF: That would leave me --

MR. BILLINGS: -- putting it strong.

DR. BORUFF: -- 20 percent, which would be a BOD of 120?

All right, I can make an arithmetic from here. Divide it by two-tenths, multiply it by five is a population equivalent,in round figures,of 1200 per ton.

Now, how many tons of paper in the State of Wisconsin?

MR. BILLINGS: I don't have that figure right now, sir.

DR. BORUFF: Oh, come. You are in the industry. You must know.

(Laughter.)

MR. BILLINGS: One is hung frequently for approximations, but in this particular basin I think that I would have to defer to Mr. Wisniewski, but I think it would be in the neighborhood of 7,000 tons. This is pulp and paper. And remember that for paper it is not 600, it is 20. For ground wood, it is not 20, it is 10 to 15. And the total figure that I have would be for the pulp-paper production.

DR. BORUFF: All right. My quick arithmetic problem, then, tells me that in this area we are talking about a population equivalent -- back to my terminology -- of around four million people. This is not a light load. And this is the residual load as per my question that you still have left after you have put into commercial usage the research that you have accomplished and you have taken out the by-product.

MR. BILLINGS: I dislike your continual reference to by-products, because there are relatively few by-products for the pulp and paper industry at the present time. In paper the waste that we remove isn't even good for fill, and when you get something that isn't even good enough to fill holes with you are sort of at the bottom of the barrel. This is broken fibers and fines and some clay-like, which has almost the same composition as river bottom clay. This is the sort of thing that escapes from our paper mill.

DR. BORUFF: I realize you have a tough waste. In the distilling business with which I was associated we also had a tough waste. But through the development of by-products we solved the problem.

MR. BILLINGS: Well, we have been attempting to solve the problem for some time, but there still hasn't been found a good use for this broken fiber that becomes almost horny in nature and the clay that escapes. Our only possibility, we feel, is for the reclamation within the mill of the clay and we are attempting to close up our mills all the time.

DR. BORUFF: Yes.

Excuse me, my friend, and we have been friends for many years --

MR. BILLING: Yes.

DR. BORUFF: -- for pursuing this discussion. My total point was to orient us as to the pollution load within your industry that you still have left to treat.

And thank you very much for your comments.

MR. STEIN: Thank you, Dr. Boruff.

I think this for the Conference, and particularly for all the people in the audience, is the real illuminating discussion between Mr. Billings and Dr. Boruff. You know, the assumption in some of these papers is all we have to do is have a little research and we are going to come out with the answer. Right here we have found that even after years of association, the people don't speak the same terms, the terms of population equivalent or BOD. Each one uses it.

Over and over again Mr. Billings in his paper used the phrase"spent sulfite liquor." It seems to me I always read in the Government reports that they talk about"sulfite waste liquor." When someone talks about a population equivalent of four million people going into the Great Lakes from the pulp and paper industry or perhaps in the Puget Sound a population equivalent from pulp and paper going in totaling more than the entire population of the area, the industry says that really isn't population equivalent; it is only population equivalent in the terms of BOD or oxygen demand possibly.

So I don't know --and I ask you to draw your own judgment -- that all we have to do is press a research button and the answer is automatically going to come out. I think we have a long way to go.

MR. BILLINGS: Mr. Stein.

MR. STEIN: Yes.

MR. BILLINGS: I would like to correct one inference that might be drawn, and that is that although the four million pounds that he arrived at -- I haven't checked on that one -- granting even that that were right, that is not all going to Lake Michigan. Phosphorus by nature is always phosphorus. When it is discharged from a mill or a plant or a detergent or a laundry or something like that, regardless of what form it is in, you can't create or destroy matter and it will continue.

But BOD or biochemical oxygen demand is quite a different matter. The end points of biochemical oxygen demand destruction are carbon dioxide and water, and the natural re-aeration of our streams and lakes will reduce this four million pounds, as he says leaves the mill,to the place where if it were a critical problem it would show up in oxygen deficiency.

I think that for five days we have heard testimony given that we do not have a problem of oxygen deficiency in the Great Lakes except, perhaps, a few tenths, I would expect that dead alewives piled up five feet deep on the bottom would create quite an oxygen demand.

MR. STEIN: Are there any comments?

We can get into a lot of that because one of the by-products you talked about was the road building. You say phosphorus doesn't dissipate. I have heard people say you put the stuff in the roads as a binder and then it rains and rains and rains over a period of time and finds its way back into the water course anyway, so the by-product doesn't keep it out of the stream.

I think we can have these theoretical arguments back and forth. All I am illustrating is I hope we will try to come up with a practical program that the industry, the States and we can agree on. We have been arguing these questions for a lifetime. I hope we live long enough to keep this up the next quarter of a century and possibly get a little closer together. I am not sure we are going to resolve them.

There is one thing I know we can do on the basis of past experience is to come up with an agreement with the States and with your industry plant by plant specifically on what you feel is reasonable that you have to do and that we feel is reasonable under the circumstances to save the water.

MR. BILLINGS: Very good.

MR. STEIN: Thank you.

Are there any further comments or questions?

MR. POSTON: I would like to comment to the effect that it has been referred to earlier when Secretary Udall's statement was given that the City of Green Bay went some 20, 25 miles to Lake Michigan for a new source of water supply because the water quality was not satisfactory in Green Bay or the Fox River.

I think this is well known, that water quality has been seriously endangered for over 10 years. There has been considerable notice given to industry and polluters on the Fox River that there are problems, and I think this meeting here today demonstrates that action hasn't been fast enough and that one of the reasons that we are here today is to stimulate action at a little faster rate than we have been going in the past.

MR. BILLINGS: Mr. Poston, your statement is absolutely correct. We want to stimulate action in every way that we can, but we think that that is exactly what is going on. I can only point again to the things that have been accomplished on the river. We in Kimberly-Clark have reduced our BOD to the river by about two-thirds of what it was a few years ago. Where we are today is only of importance and relative to where we have been and where we are going.

I think we are going. Whether it will be rapid enough or not to suit everyone I don't know, but I am sure that everyone has the message loud and clear.

MR. STEIN: Right.

Are there any further comments or questions?

One of the Conferees told me we should not badger the witness from the Badger State.

(Laughter.)

MR. BILLINGS: Mr. Chairman, I would like to point out one last factor that makes my appearance before you today particularly appropriate.

Monday was my birthday, which means that I was born under the sign of Aquarius, the water bearer.

(Laughter.)

(Off the record.)

MR. STEIN: Mr. Holmer.

MR. HOLMER: Is Mr. O. A. Jahnke in the room?

From Milwaukee, a consulting engineer, Mr. Herbert Moore, has asked for an opportunity to present a statement.

STATEMENT OF HERBERT MOORE
CONSULTING ENGINEER
MILWAUKEE, WISCONSIN

MR. MOORE: Mr. Stein, Conferees, Ladies and Gentlemen.

My name is Herbert Moore, Consulting Engineer, Milwaukee, Wisconsin. I haven't a paper. I am speaking without notes.

I would comment that I asked Mr. Freeman Holmer to appear after reading the program of FWPCA and the recommendations,and I felt compelled to comment that this program would actually impede the pollution abatement of Lake Michigan. I would like to indicate in what manner I think this would occur, because it could be corrected, of course, and a Federal Program instituted that would help abate pollution.

It seems to me that it is too rigid and that the timetable is peculiar. It is too rigid in requiring primary, secondary and tertiary installations,and I fear would cause communities to proceed not cautiously in projecting sewerage and sewerage treatment facilities at sites that might not be appropriate and efficient in the long-range meeting of demands for an ultimate solution of the problem.

The time lag of five years for abating pollution from overflows strikes me as being very bad. I would ask the question, what is the difference between pollution from overflows and any other pollution? And this time lag is harmful to the total cause of pollution abatement.

I don't maintain as an engineer that the correction of overflow problems is as simple as merely putting in a pump and storing the liquid and treating that liquid. But it is associated, definitely, with the program of pollution abatement and should not be separated and thus cause undue emphasis to be placed upon existing facilities, which the recommendations in the report gives a blessing. On Page 24 you can note the words indicate that primary and tertiary plants would not become obsolete, the fact that there are new methods being devised would not deter us from proceeding with phosphate removal now, and that existing facilities would not become obsolete. I think they would become obsolete. I do not like to see the Federal Government give its blessing to proceeding with the use of existing sites that may be completely wrong.

I would like to say that Wisconsin, it seems to me, is a leader in this water pollution abatement field with the splendid new water law, a giant step forward. I feel that the present proposed Federal recommendations would slow down Wisconsin or cause Wisconsin to spend a lot of money needlessly towards pollution abatement that would be ineffective.

What is needed from the Federal Government is a set of standards. Instead of coming in with standards that are mediocre, which, of course, the States have had for years, they should come in with a set of standards that are higher and thus give help to the States and direction to communities, rather than a pat on the back and to say go ahead with what you are doing and keep on doing more of the same and this will result in hundreds of millions of dollars being spent needlessly. Direction is needed.

I would refer also to an item on Page 66, which I think is a fundamental mistake of the report, Paragraph 15, which stipulates that small disposal plants, because of the operating problems, would be frowned upon by the officialdom and that in fringe areas in large metropolitan areas, of course, they should be connected up with the big sewer systems.

I feel that this is the wrong point of view and that this perhaps is a point of view that is prevalent in so many cases of water pollution abatement. The big answer is considered meritorious where actually the real answer may be improvement in technique and operation of the small plant, saving great sums of money on sewer expenditure, and perfecting operation and abandoning the septic process and going into aeration processes and going into ground water recharge and opening the door to a containment of liquid wastes rather than the collection of liquid waste to a yet bigger plant. And this point of view, if it could be corrected, would induce communities to begin to solve the problems logically.

I, therefore, say that the Federal Government could be of help, but at present, under the present program, I fear that it would actually be a hindrance.

Thank you.

MR. KLASSEN: Mr. Chairman, I would just like to ask this witness one question and that is all.

In his capacity as a consulting engineer, I am wondering, are you a consultant to any of the industries or cities that are named in this report or on the spot?

MR. MOORE: Not to my knowledge, Clarence.

I would like to comment further and say that it seems to me that Illinois, with its, let's say, abatement of pollution of Lake Michigan,is rather out of the picture of this Conference and is in a splendid position to say to the others, clean up, but at this Conference it certainly isn't appropriate to comment on the mediocre standards that the State of Illinois has had, and that is all they could do, I suppose, because other States did the same, and so we now are tending to project mediocre standards as a formal rigid pattern which is, I don't think, healthful.

MR. VOGT: Mr. Moore, with respect to your comments on the Federal Recommendation 15 about maximizing the use of areawide sewerage systems, which apparently you don't agree with, are you then advocating, say, as a community grows that a sewage treatment works be constructed for each subdivision as it develops in a community or in an area? Is this what you are advocating?

MR. MOORE: I am advocating the idea of dispersal of sewage at fringe area subdivisions, yes, rather than collecting that sewage and bringing it into a central plant.

MR. VOGT: On what basis do you make this recommendation?

MR. MOORE: Well, I make this recommendation on the basis of, let me say, new evidence that is indicating and proving that aerated liquid will pass into the subsoil at a higher rate than septic liquid will, and this gem of an idea hasn't apparently been exploited very fully up to now, but perhaps will be with the need for water pollution abatement. And, therefore, the subdivision at the edge of a large city, to justify its existence as a subdivision, you see, and to justify its being created, would have to provide the land area necessary for providing, let's say, aqua for recharge if appropriate to that particular area as the best solution.

MR. VOGT: Are you saying to do this on an individual home septic tank system or a community collection system with treatment and then disposal into the ground?

MR. MOORE: The ideal, of course, would be for the individual home, with the individual well and the individual solution to the problem on the premises that would be developed and proper evapo transporation soil treatment provided to solve the problem for the individual home.

MR. VOGT: This is certainly contrary to our experience in Michigan where we have run into numerous problems because of the geology of certain areas where this is just not feasible.

MR. MOORE: I grant you where the geology is not feasible and the rock outcrop is near the surface of the ground, sewers to a remote area would be necessary.

MR. VOGT: Not rock outcropping. We have very little rock outcropping in Michigan. Most of ours is unconsolidated materials, and in many areas we get into tight clay soil where your proposal would just be not feasible at all. In fact, we are now doing precisely what is recommended here in the Federal Report, to go to areawide collection systems to avoid sewage outcropping on the ground and running into the roadside ditches.

MR. MOORE: I think the answer in that case would be aeration of the liquid and preparation of the soil for evapo transporation. I think this can be done in a given area. The idea would be that the liquid, instead of being introduced deep in the ground as we now propose in all the State plumbing codes with septic tank provisions, let that liquid be aerated to create an aerobic environment for bacteria and let that be introduced into the topsoil so that it would evaporate or be useful for irrigation and be disposed of in that way.

MR. VOGT: Of course our plans do essentially this. In fact, we recommend disposing of the liquid at a depth not greater than 24 inches, and we still have run into problems. So our experience has been contrary to your proposal here.

MR. MOORE: Have you aerated the liquid?

MR. VOGT: Yes, we have also tried extended aeration type treatment works.

MR. MOORE: Thank you.

MR. POSTON: Are there any other questions of Mr. Moore?

Mr. Holmer?

(No response.)

MR. POSTON: If not, thank you, Mr. Moore.

Mr. Holmer, you may proceed.

MR. HOLMER: Is Mrs. Robert Erickson in the room?

We have been involved with cows and foxes and badgers, and now I turn our attention to the wolf.

The Wolf River in Wisconsin was the origin of a regional planning commission, which has since been renamed the Northeast Wisconsin Planning

Commission. We are fortunate in Wisconsin in having two major planning commissions, one covering the southeast seven counties, including Milwaukee, Racine and Kenosha, the other covering 14, I believe it is, of the northeastern Wisconsin counties that are endeavoring to develop a coordinated and cohesive program for the management, among other things, of their natural resources.

The Northeast Wisconsin Regional Planning Commission has embarked on a specific and intensive hydrological program.

Here with us this morning are the Vice-chairman of the Northeast Wisconsin Regional Planning Commission, Mr. Eugene Garrow -- excuse me, Chairman of the Standing Committee on Water Resources Conservation--Mr. Tom Pitt and Gerald Paul, the hydrologist for the Northeast Wisconsin Regional Commission.

Mr. Paul will present the report of the Commission.

STATEMENT OF GERALD PAUL
CHIEF HYDROLOGIST
NORTHEASTERN WISCONSIN
REGIONAL PLANNING COMMISSION

MR. PAUL: Thank you, Mr. Holmer, Conferees, Ladies and Gentlemen.

My name is Gerald Paul. I am the Chief Hydrologist for the Northeastern Wisconsin Regional Planning Commission, and I have been asked to present this statement for that Commission.

The Northeastern Wisconsin Regional Planning Commission represents a nine-county area centered along the upper portion of the Fox and Wolf Rivers. The watersheds of these major Wisconsin rivers combine to form the largest tributary in the entire Lake Michigan Basin. Approximately 6,000 square miles of drainage area contribute flows which are discharged into the Lake via Green Bay. The Northeastern Wisconsin Regional Planning Commission would like to go on record as standing ready to assist in any efforts to "save our lake". We are already heartened by two objectives of this Conference:

1. The positive attitude that corrective pollution abatement action must be taken--and will be taken.

2. The concern for inclusion of the tributaries and their originating sources of pollution contribution and relevant problems.

The people of our area of Wisconsin have long been concerned about the progressive deterioration of our vital water resources and what ultimate effect it would have on the way of life for the inhabitants and others. In 1958 an organization (The Wolf River Improvement Association) was formed by concerned citizens to protect, restore and preserve the Wolf River for future generations. Through their efforts the Wolf River Basin Regional Planning Commission (comprising seven counties) was created, by the then Governor Gaylord A. Nelson. A staff was hired, a comprehensive plan developed, other counties added, and the name changed to the Northeastern Wisconsin Regional Planning Commission in 1967.

The Planning Commission, having been founded by citizens concerned about water quality and purity, is devoting much of its staff time to assisting the nine member counties in the planning fields of flood plain zoning, sewer and water, and sanitary codes in addition to stream flow and chemical analysis of the waters at 107 monitoring stations. The stream flow and chemical analysis, data gathering which started December 8, 1967, is performed by two highly qualified staff people, myself, Mr. Gerald Paul, Chief Hydrologist-Civil Engineer, and my associate, Mr. Boyd Kinzley, Director of Natural Resources. Our sewer and water comprehensive planning assistance to our nine member counties is provided by Mr. Frank Hedgcock, Chief Planner, and his assistant, both members of the Planning Commission staff who have been active in this field for the Commission since September 1, 1967.

A few more statistics are essential to understand the problems confronting the Northeastern Wisconsin Regional Planning Commission and its nine member counties, and the pollution abatement of Lake Michigan:

(1) The combined Fox-Wolf River, as mentioned, is the largest tributary to Lake Michigan with a mean of 4140 CFS. This is almost 1 1/4 times the amount granted the State of Illinois for

diversion purposes.

(2) The drainage area of this watershed, served by the Northeastern Wisconsin Regional Planning Commission, is approximately 5,817 square miles or approximately 90 per cent of the total acres that drain into Green Bay. There are 233 miles of river from Hiles, the start of the Wolf River, to Lake Winnebago.

(3) The population of this area in 1930 was 253,540 and 320,629 in 1960, with a projection of 398,000 by 1980.

(4) The 1962 per capita income of residents in the region was $1,780 with one out of every two households in the rural counties having incomes of less than $4,000 in 1962 compared to less than one out of every three in the urban counties.

(5) In this region there are a total of 116 incorporated municipalities and unincorporated villages consisting of 67 unincorporated villages, 39 incorporated areas of under 5,000, 5 incorporated areas of 5,000 to 9,999 population, and 5 incorporated areas with a population of 10,000 or over, the latter being in the

lower reaches of the region primarily.

The points we would like to make are as follows:

(1) Urbanization along our regional waterways, we feel confident, will be controlled by enforcement of our Water Resources Act which deals with flood plain and shore line zoning. However, the 67 smaller unincorporated villages and some of the 39 cities of under 5,000 population are faced with a preponderous problem of compliance. Some of them are polluters, dumping raw sewage into the river; they know it; they want to do something about it but they do not have the tax base to provide the necessary means. They have received State orders to comply -- they will be cited and possibly prosecuted unless State and Federal grants are forthcoming. We invite this Conference to take special note of this situation as it no doubt exists in the other neighboring States as well and deserves the serious consideration of all concerned and the support of Senator Nelson's proposal of 90 percent assistance for sewage treatment facilities.

(2) We recommend surveys for comprehensive recommendations relative to the interrelationship of surface and ground waters to avoid contamination of our water by indiscriminate selection of sites for waste disposal.

(3) We recommend that Congress be asked to expand "701" planning grants to include funds for hydrological studies.

(4) We heartily endorse the watershed approach to our water resource problems and recommend that the Federal and separate State Governments seriously consider all aspects of the use of data processing equipment for central recording and reporting of technical information pertaining to water resources; permits such as flowing well discharge; well drilling; channel enlargement; daily industrial consumptive use of water, etc., so effective up-to-date water administration can be effective.

(5) We recommend that 100 per cent abatement of human pollution of Lake Michigan be the goal of this conference and its ultimate proposals, for if this goal is not attained and maintained by us and our successors the compounded problems

of the future can only prolong the date of the ultimate death of Lake Michigan.

We recommend further that siltation be classified and dealt with as a pollutant. Sources of information tell us that the Wolf River is the recipient of approximately 700 tons of silt annually. This originates from two major sources, namely, wave wash assumed from pleasure boats in the navigable portion of the river and agricultural lands throughout the area. These two sources of siltation presently do have programs in progress to alleviate this condition; however, they are inadequate and must be expanded upon.

(1) Stream bank erosion can currently be corrected on agricultural land by the farm owner cooperating with the ASCS, on a cost-sharing basis. There are two drawbacks to this program:

(a) It is not compulsory.

(b) There is no provision for cost sharing assistance on non-agricultural land. However, our Planning Commission has called the latter to the attention of Senator Nelson asking that the ASCS Program be expanded to include non-agricultural land also.

(2) Subwatershed development is possible under PL 566 but must be accelerated throughout the Lake Michigan watershed if we are to maintain the carrying capacity of our surface water systems and prevent silting eutrophication of our reservoirs.

We recommend that the current trends and proposals to separate storm and sanitary sewer systems be given a long, hard look. Are we ultimately going to have to treat storm sewer water because of the increased use of calcium chloride? If so, are we actually doing the right thing by separating these systems or would it be more practical and economically feasible to spend this time and money in building treatment plants, now?

We wish to thank you for the opportunity to present our views and pledge our fullest cooperation to preserve Lake Michigan, one of our greatest heritages.

Respectfully submitted,

(signed) Gordon A. Bubolz

Gordon A. Bubolz, Chairman
Northeastern Wisconsin Regional
Planning Commission

(Signed) R. E. Garrow
R. E. Garrow, Chairman
Standing Committee on Water Resources
Conservation

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MR. STEIN: Thank you, Mr. Paul.

Are there any comments or questions?

Mr. Vogt.

MR. VOGT: Mr. Chairman.

Mr. Paul, on Page 3 (3019) you indicate that the smaller communities which admittedly are polluters and dumping raw sewage into the streams, they recognize this, they want to do something about it, but you allege that they do not have the tax basis to provide the necessary means.

On what basis do you make such a judgment?

MR. PAUL: Well, in line with some of the water quality work that is being done in that area and in line with the water quality criteria which has been developed, various monitoring of numerous streams in our region has been done. These certain communities have been cited as major polluters.. However, legislation, I believe, from the Attorney General's office levies huge sums, I can't recall any particular figure, maybe Mr. Holmer can back me up on this, I think it is something like $500 thousand for a community of in the neighborhood of maybe 300 people. This is the --

MR. VOGT: You are just talking in generalities?

In other words, it seems to me that if you claim that the communities are not financially able to correct their pollution, you should have some basis for this, and it seems that there would be ways and means of determining this. Do you have this information?

MR. PAUL: I don't have that at my disposal. It does seem evident --

MR. VOGT: On what basis did you make that statement, then?

MR. PAUL: It was made from actual figures, which I don't have here.

MR. HOLMER: Mr. Paul, Gene Garrow is right behind you. He may have an answer to the question.

MR. GARROW: In answer to your question, sir, there is the Village of Fremont of a population of approximately 575 to 600. The cost of engineering estimate for sewage treatment plant for this village is $403,000. Their gross assessed value is somewhere in the neighborhood of $2 million.

This is a town of retired people, elderly people, who retired on very low income, are operating very close to the belt, so to speak, and comprised probably of a greater percentage of widows per capita than the national figures would reveal. In other words, I think there is something like between 35 and 45 widows occupying separate houses, separate entities.

This particular village of the Wolf River is located in the flood plain and the 100-year flood stage did create a flooding condition of practically the majority of the downtown business district as well as many of the residential areas.

They have pursued for the past three years, at least, the course of seeking assistance from the State of Wisconsin, Federal funds, whatever sort of grant would make it possible to accomplish the sewage treatment of their effluents from the City. At the present time they dump into the Wolf raw sewage, all of them, practically all of them. The saturation of soils is such that they are at a point of, as we say and as has been used here, of no return. There is no alternative to speak of at the present time other than to go to a sewage treatment plant.

However, they feel and had a meeting as recent as last night and expressed their opinions that they are in no position for a bonding for a period of 50 years because the revenue from this facility would not be sufficient to operate the plant and most assuredly their present assessed valuation and income of the village is in no position to provide this added income for operational monies.

Does this answer your question, sir?

MR. VOGT: This is just one example, sir. I wouldn't expect that every community would be in a flood plain where some means of pollution control couldn't be exercised, even going to Mr. Moore's suggestion here earlier where a small village of, say, 5 or 6 hundred people might even go to individual septic tanks with in-ground disposal, thereby removing their wastes from probably the storm sewers that are thereby polluting the near-by stream. I would think that this might well be a solution in some instances.

In other cases I think it is incumbent upon these communities to do the very utmost from the standpoint of attempting to finance as much as they can over a period of time. It may be that they have to do this in a stage program, but at least get going rather than just throwing up their hands and saying we can't do it.

MR. GARROW: Sir, would you call get going three years of diligent efforts to seek assistance throughout various State agencies and a meeting as recent as last night with the Federal Housing Administration? Their legal counsel and the -- there was one other man there in attendance from one of the agencies. I think that in a small village like this when you have approximately 30 people out, this is a pretty good representation.

By no means do I wish you to feel or entertain the thought that Fremont is the isolated instance. This flood plain extends all the way practically to Shawano. Mr. Paul can point out here for your benefit where Shawano is in relation to Lake Winnebago, and you will find that this is a matter of approximately 100 miles and perusal of the map will show you that there are many small unincorporated villages.

Research will show you that many incorporated villages still are not in a financial position to accomplish this at this time without Federal or State grants. We have been informed or the Village of Fremont has been informed that State and Federal grants have been earmarked for at least 1969. State compliance requested required that they comply by January 1968.

MR. VOGT: Sir, I don't mean to imply here that we don't have the same problems in Michigan, because we do. We have small communities. But I think the position I am taking here is the same position I take on our Water Resources Commission in Michigan, that poverty isn't an excuse for pollution and that the communities just can't seek outside aid to solve their problems. They must do as much as is physically possible with their own funds and then if there is a gap between what they have and what they need, maybe they can seek some outside aid.

But it is incumbent for them to do the maximum with their own resources, and this is about the same story we tell our smaller communities in Michigan which are faced with the same problem that you folks in Wisconsin have.

MR. GARROW: We as a planning commission are working very closely with these people. We are attempting to steer, guide them and aid them in any way possible. It does become frustrating when there is the earnest effort to comply and there is also the sound logical reasoning that they just financially can't comply.

We feel confident, however, that our State agencies are aware of this. But I think that we wanted to bring this to light,feeling that possibly previous speakers had not sufficiently elaborated on this particular point. If we are going to clean up Lake Michigan, it has many facets. We can't only look at the obvious pollution that is visible; we must do a little research and go into the back country, the originating sources of water, and pick up the polluters whoever and wherever they may be and arrive at this determination of how we are going to cope with it. This is only a segment of the problem that we are pointing out to you for your information at this time.

MR. STEIN: Thank you very much.

Are there any further questions or comments?

If not, thank you.

MR. HOLMER: I have one question of Mr. Paul or Mr. Garrow either one.

I would like you to indicate briefly the sources of funding for your hydrological program.

MR. GARROW: We are operating under a very stringent budget. The way the Planning Commission of the State of Wisconsin is set up is that we are allowed to -- the counties ask to form a regional planning commission and the State statutes provide that if it is granted and approved by the Governor that three ten-thousandths of a mill of assessed valuation is allowable. I think that this primarily was one of the reasons that the population of these nine counties was pointed out, because in the funding of a planning commission such as this there are many facets to planning and demands upon planning, and it is comprehensive planning involving all these other things such as economic development, population expansion, explosion, if you will, among other things, land use, and as a result, in order to service all of these member counties, monies have to be divided, in our instance down to where we can only afford at the present time a hydrologist -- and believe me, gentlemen, this took us three and a half years or four and a half years to get a hydrologist, civil engineer, which Mr. Paul happens to be -- and with the magnitude of the job you can see we are only scratching the surface.

Now, these funds in addition are supplemented and augmented by some Federal funding, local funds, et cetera. However, our budget is not that high that we feel that we can do a full water resource pollution abatement job unless we do have additional assistance from possibly the new District 3, which involves our area, or possibly your recognition of the fact that we are a major contributor to the Lake Michigan watershed.

MR. HOLMER: That was part of the answer, at least, Mr. Garrow.

My reason for asking the question, Mr. Stein, is that this has been an interesting cooperative program and in the details at the back of your records you will find that part of this program is financed out of a Federal appropriation for comprehensive water planning, and a somewhat larger amount has been allocated from the State budget to help finance this program as well as your local tax funds which are providing the base for the program.

It is an important one and it ought to be supported, but it is also an example of inter-governmental cooperation involving all three levels.

MR. GARROW: Thank you, Mr. Holmer.

MR. STEIN: Are there any further comments or questions?

(No response.)

MR. STEIN: If not, thank you very much.

Mr. Holmer.

MR. HOLMER: Before I begin, I would like to ask if there is any resident of Wisconsin who desires to present a statement to this Conference who has not had that opportunity?

Yes, sir.

MR. JAHNKE: After awhile.

MR. HOLMER: No, first.

Mr. Jahnke?

Mr. O. A. Jahnke of Milwaukee.

STATEMENT OF O. A. JAHNKE

MILWAUKEE, WISCONSIN

MR. JAHNKE: I have no paper.

Mr. Stein, Chairman, and Conferees.

I feel awful ashamed to have to come up here in order to protect Lake Michigan.

My grandfather and your grandfathers and fathers passed a law for us, Section 13 of the River and Harbor Act of March 3, 1899, which reads:

"Under Federal law enacted by Congress it is unlawful to deposit or discharge or cause to be deposited or discharged any refuse matter of any kind or description whatsoever from any ship, barge or other floating craft of any kind or from shore docks or wharves into any navigable waters of the United States."

That includes the whole 50 States.

"Also unlawful are deposits of this nature on shore of the waterway or on shore of a tributary where the refuse material is liable to float or to be washed into the navigable water. Included in the term 'refuse' are petroleum products, garbage, debris of any kind, other kind of refuse, including bottles, paper, and so forth."

The prescribed penalties for this violation and conviction of this statute reads substantially as follows:

"Every person, corporation or company that shall violate or shall knowingly violate, aid, abet, authorize or instigate a violation of this law shall be guilty of a misdemeanor and shall be punished by a fine not exceeding $2,500 nor less than $500 or by imprisonment in case of a person for not less than 30 days nor more than one year or by both fine and imprisonment at the discretion of the Court."

That is the end of the quotation of this law.

When the Jesuit priests and the early explorers first came up on the Lakes in 1634, they called the Great Lakes the Oceans of Sweet Water. And when I was a boy, I was born right on Lake Michigan right north of Manitowoc there, my grandfather bought Grants Pier. They didn't have harbors in them days. I used to play down at the lake from the time I was about five years old, and whenever I got thirsty I used to take my hands and make a little cup and take a drink, but I don't believe we can do that today.

I just wanted to read from this law that was passed in 1899 for the records and the Government records, because if we had followed up from that time on we wouldn't have needed this Conference today.

Thank you very much.

MR. STEIN: Thank you.

(Applause.)

MR. STEIN: I say this for the purpose of the record, and I see the Corps of Engineers are in here, this is not a new statute. This must have been at least the ten thousandth time I have either read it or heard it. It is not an easy statute to read. I think if the statute purported to clean up all pollution we wouldn't need our Federal program or our Federal law. The courts have litigated this statute for years. The Corps of Engineers has administrated it.

The pollution referred to refers to pollution which interferes with navigation.

Would you continue.

STATEMENT OF FREEMAN HOLMER
ADMINISTRATOR, DIVISION OF RESOURCE DEVELOPMENT
WISCONSIN DEPARTMENT OF NATURAL RESOURCES

MR. HOLMER: Mr. Stein, Fellow Conferees.

I want to thank all of the witnesses, Mr. Jahnke and Mr. Moore and Mr. Billings and Mr. Ewens, and I would like also to thank our women representatives who have appeared here before, Mrs. Dahl yesterday, who has sent to us a telegram this morning addressed to the FWPC Conferees, which reads as follows:

"Even as this group discusses pollution problems an atomic power plant is discharging ten degree thermo pollution into Lake Michigan. Additional plants will add more. Experts admit ecological changes. Controlled freezer unit using cheaper atomic power to cool the extra ten degrees would eliminate the problem in the lake, also in the Alaskan salmon spawning rivers and in Florida's Biscayne Bay, saving large industries as well as natural beauty. Another example of the 'new approach'" which she suggested yesterday.

In addition to Mrs. Dahl, we had at earlier sessions speaking for national groups Mrs. Donald Clusen, of the League of Women Voters, who comes from Green Bay, and a statement distributed yesterday on behalf of the General Federation of Women's Clubs by Mrs. G. L. McCormick of the Milwaukee area.

This morning I received another telegram from Mr. F. M. Baumgartner, President of the Citizens Natural Resources Association of Wisconsin. It reads as follows:

"The Citizens Natural Resources Association of Wisconsin supports the goals of this Conference. We recommend that a moratorium be declared on the application of pesticides that are contributing to the rapid degradation of the environment throughout the Lake Michigan area."

Signed by F. M. Baumgartner, President, CNRA.

On Monday in the United States Senate Senator Nelson, who was with us last week, addressed the members of the Senate, and included in his remarks were four paragraphs which I think we as

Conferees need to bear constantly in mind as we come to grips with the problems that confront us in our role here.

Senator Nelson said:

"The Governors of the four States called to this Conference have designated as their representatives the heads of their appropriate conservation water resources or natural resources departments. These men are all thoroughly experienced in the field of water pollution. Most of them are veteran administrators of their own State programs designed to clean up pollution. This, of course, puts them in a difficult position. All of them are proud of their own State programs, all of them are somewhat sceptical of Federal 'interference' in their water pollution programs."

I am going to return to Senator Nelson's quotation in a moment, but let me pause here long enough to say that anyone who denies the fact that the existence of someone looking over your shoulder causes a degree of skepticism at any point need only be here or in our home States when there are those who offer advice or counsel or restriction, and this applies to all of us, because we all look over each other's shoulders in this business and there is a tendency to be if not skeptical at least nervous.

Senator Nelson went on:

"It is going to take real statesmanship on the part of these men to rise up to the challenge which the Conference presents to them and to agree on a really bold set of recommendations which will clean up Lake Michigan. They may be called upon to make recommendations which will be painful for them and others in their States to accept, but there is no alternative if we are to save Lake Michigan."

Yesterday in his address to us Governor Knowles provided an answer and a guide to the Wisconsin Conferees when he said clearly and boldly, "Wisconsin is prepared to cooperate fully in support of the recommendations which are developed in this Conference. We are unequivocally committed to meet our responsibilities in the preservation of Lake Michigan."

Wisconsin law declares it to be "the express policy of the State to mobilize Government effort and resources at all levels, State, Federal and local, allocating such effort and resources to accomplish the greatest result for the people of the State as a whole." Twice it affirms "the importance of Lakes Superior and Michigan and Green Bay as vast water resource reservoirs," and the necessity for high water quality standards relating to these waters.

In pursuit of this statutory directive, Wisconsin Administrative Code declares the initial intention that the open waters of Lake Michigan shall meet the standards for all uses, that swimming beaches meet the standards for body contact recreation and that the harbor areas (in the vicinity of pollutional outlets) be raised to meet what are really exacting minimum standards. The long-range goal of Wisconsin intrastate standards, including those inland waters which are a part of the Lake Michigan Basin, is "to permit the use of water resources for all lawful purposes," including the reproduction of game fish and minnows. The "working objective" is already declared to be to achieve these goals within ten years.

Achievement of this goal requires the cooperation of industry, local Government, and private citizens. State financial assistance to municipalities and tax incentives to industry have been provided to encourage such cooperation. Administrative orders, enforceable in the courts, are available, if needed, to assure compliance.

With specific respect to Lake Michigan, the State or Wisconsin submitted to the Department of the Interior initial water quality standards and a plan for their implementation. We are gratified that these have merited approval by the Department and request that they be incorporated in the record of this conference, along with a copy of the Wisconsin Water Resources Act of 1965 and related legislation.

Subsequently I shall make reference to certain other documents evidencing the Wisconsin Program. These are included in two rather large notebooks which have been distributed to the Conferees, and I would suggest rather than incorporating these at the points in my remarks that they be incorporated as a single exhibit.

MR. STEIN: Do you want them as an exhibit or part of the Conference transcript, Mr. Holmer?

MR. HOLMER: As an exhibit, sir.

MR. STEIN: Without objection, that will be done.

(Which said documents are marked Exhibit and are on file at the Federal Water Pollution Control Administration Office in Washington, D.C., and at the Regional Office of the FWPCA in Chicago, Illinois.)

MR. HOLMER: The communities and industries affected by the plan of enforcement have been notified of our intention to enter the necessary pollution abatement orders promptly. You will find in that planned implementation target dates and the specific requirements. We have deferred entering formal orders to these municipalities and communities, first while we were awaiting the approval or modification of our standards in the processes of review in the Department of the Interior,and more recently in anticipation of this Conference. We intend, of course, that our plans and orders will reflect the results of this Conference and they are, these plans and orders, merely the next steps in our continuing program of pollution abatement.

We will make no effort here to enumerate all of the past or present steps being taken to abate the pollution of Lake Michigan by Wisconsin communities and industries. These are in many respects detailed in the documents which have been distributed to the Conferees. The Conferees already know that Milwaukee has been a pioneer in secondary treatment and is scheduled for improvement of its collection and treatment facilities over the next ten years at an investment of approximately $150 million in local funds. Kenosha dedicated its new secondary treatment plant last October. Racine's new secondary facility is under construction. Green Bay and Milwaukee (in efforts which have been encouraged and financially supported by the Federal Water Pollution Control Administration) are deeply engaged in major research dealing with papermaking wastes, nutrient removal, and the management of storm runoff.

Other efforts in the Lake Michigan Basin are or will shortly be under way in the Lake Michigan Basin in Wisconsin to abate pollution. Some of these will result from recent surveys of the Fox River and the Root River and recent hearings thereon. The reports of these and other basin surveys should also be made a part of the record of this conference, and they have been distributed. We are taking these and similar steps in the confident expectation that our actions will have a favorable effect on the character of the waters of Lake Michigan. Further surveys in 1968 will complete current coverage of the streams in the Lake Michigan Basin.

The news release on December 21 announcing this Conference listed seven specific forms of pollution among those which should be considered here. There are others that have been included in the report of the Federal Water Pollution Control Administration, including urban and agricultural runoff, sedimentation, and the matter of persistent pesticides.

Of the seven items originally listed, three (dumping of dredged material, oil pollution, and control of discharges by commercial and pleasure craft) clearly require national standards and a consistent program among Federal agencies.

Three of the listed items (treatment of municipal and industrial wastes, thermal pollution, and beach pollution) seem clearly within the province of the States. It is essential, however, that the States be enforcing adequate and comparable standards and that the programs of the States be coordinated. Michigan, for example, has adopted a bold program addressed to the alewife nuisance; Wisconsin is sharing in the enterprise. We will continue to collaborate with the other Lake Michigan States, and the Federal agencies, through the Great Lake Basin Commission, in the development and execution of a comprehensive program.

The seventh listed problem (the overenrichment of shoreline waters by nutrients) is especially crucial. And may I say that the next few paragraphs were written before this Conference convened, and I want to say something about them after I read them as they were written two weeks ago.

Phosphorus, nitrogen, and other nutrients enter the Lake from a multiplicity of sources, many of them natural. The Subcommittee on Air and Water Pollution of the Senate Committee on Public Works has reminded us that "even in the absence of man, lakes would eventually die. . . .through natural runoff, sedimentation, and changes in the biological balance of the Lake."

This process of aging is inevitable, although it may, for long periods, be imperceptible. It is marked by "increased fertility and the proliferation of algae."

FREEMAN HOLMER

The Committee Report (No. 917, 90th Congress, 1st Session) goes on to observe that "Present knowledge of eutrophication and potential techniques of prevention and reclamation....is too limited to begin a full-scale program of Federal involvement....We lack adequate technology to deal with the problems of diffuse sources, natural and man-influenced, which characterize the principal contributors to eutrophication."

Yesterday when Mr. Purdy was at this microphone, I posed a question to him and I got an answer. The question was, given the existence of all of the alewives and their provision of phosphorus to the shoreline waters whether it really made a great deal of sense to begin with a major effort at the removal of phosphorus from municipal and industrial waste facilities.

And his answer, I think, helped to clarify my own thinking, which had been severely influenced by the statements last Wednesday by Dr. Baumgartner and Dr. Weinberger. The problem of phosphorus and its elimination is clearly a critical one, and while there are vast gaps in our knowledge and subject to further review of the recommendations submitted to us by the Federal Water Pollution Control Administration, it seems clear that we need to take all feasible steps in this area as rapidly as we can.

Wisconsin policy is clear. The decision has been made to enhance the quality of all Wisconsin water and particularly to control, to the extent feasible, the processes of eutrophication in all our lakes, including Lake Michigan. The odds against us are significant but we are determined and have directed our efforts to arrest and reverse the process. We propose that this conference face the problem squarely and realistically; as though we ever had any other intention. We suggest that this requires substantial research and submit for incorporation in the record of this Conference a pioneering report "Excessive Water Fertilization," developed by the State of Wisconsin. This joint effort of the University of Wisconsin and State agency personnel offers a number of specific recommendations that deserve consideration and adaptation by this Conference.

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(Which said report is as follows:)

3048

EXCESSIVE WATER FERTILIZATION

Report
To The

WATER SUBCOMMITTEE
NATURAL RESOURCES COMMITTEE OF STATE AGENCIES

By

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Madison, Wisconsin
January 31, 1967

January 31, 1967

Mr. H. E. Wirth, Chairman
Water Subcommittee
Natural Resources Committee of
State Agencies
P. O. Box 309
Madison, Wisconsin 53701

Dear Mr. Wirth:

The working group on Control Techniques and Research on Water Fertilization has been charged with the problem of excessive fertilization of our lakes and streams. We were asked to study the need for removal of nutrients and to make recommendations concerning proposed state policy or programs in this field.

The accompanying report, "Excessive Water Fertilization," represents the efforts of our group in complying with the request. This report outlines the problem; the key nutrients, their sources and estimated contributions; control methods and makes recommendations. A summary and the recommendations are in the first part of the report.

This report, we feel, fulfills our responsibility. However, if we can be of further assistance, please contact me or any member of the working group.

Very truly yours,

F. H. Schraufnagel

F. H. Schraufnagel
Chairman
Working Group

JM

SUMMARY

The State of Wisconsin is blessed with many lakes and rivers. Some of these waters are showing signs of deterioration in water quality as a result of receiving excessive amounts of nutrients. It is highly likely that the frequency and severity of these problems will increase with further urbanization and recreational use. We believe that excessive fertilization will become our most important public problem in water resources. Every possible action should be taken at this time in order to minimize additional deterioration in water quality.

Sources of nutrients (or fertilizers) are numerous. Domestic sewage, even when treated to a point where the effluent is sparkling clear--in fact, suitable for trout rearing, contributes a major source of nitrogen and phosphorus. These two elements are generally considered the most important contributors to excess fertilization of Wisconsin waters. Conventional treatment facilities are presently removing less than half of these nutrients, although they efficiently remove the suspended solids and oxygen consuming substances that have traditionally given sewage its unaesthetic connotation. The volume of domestic sewage will not only increase with increasing population but the accelerated use of the plant nutrient phosphorus in synthetic detergents for our laundry and kitchen sinks appears to be adding to the problem.

Another major source of nitrogen and phosphorus is runoff from rural lands, particularly manured croplands. These fertilizers reach lakes and streams via overland runoff and underground percolation. The major potential source of these fertilizers is surface runoff from manure applied on frozen soil. Commercial fertilizers do not appear to be significant sources except in some areas with specialized crops.

Urban runoff, another major source of nutrients, will continue to rise as the surfaces of the landscape become increasingly covered with roads and roofs. Precipitation onto water surfaces also makes a significant contribution of nutrients through the action of "washing" the atmosphere.

The development of wetlands for agricultural and urban use also brings about an increased rate of decomposition of organic materials so that seepage and runoff from these soils may contain large quantities of nitrogen and phosphorus. Various kinds of industrial wastes are also rich in nitrogen and phosphorus. They do not appear to contribute the volume of these nutrients that domestic sewage or rural and urban runoff do but can be important in local situations.

The solution to the malady of excessive water fertilization is best obtained by prevention. Better removal of nutrients from sewage appears possible by several methods. Improvement of present sewage treatment operations is possible, as is adding an additional stage (tertiary treatment) for effluents now released as "finished" products. The use of chemical precipitants has shown considerable promise in pilot plants and can undoubtedly be perfected further. The biochemical removal of nutrients by growing and harvesting algae in effluent holding ponds seems an ideal method of removing nutrients, but experimental trials to date have demonstrated several problems that have not been solved. The removal of nitrogen by modifying the present activated sludge process shows promise, but to remove phosphorus requires a different modification. Liquidization of winter manure and storage until spring may prove to be an effective measure.

Harvesting plants and animals from lakes as a control method has much in its favor as it suggests a use for these fertilizers. Unfortunately, the quantities of fish and aquatic plants which must be removed in order to offset the input of nitrogen and phosphorus cannot possibly be attained. However, harvesting and refuse removal, coupled with better sewage treatment and control of nutrients in rural runoff, may go a long ways towards solving the problem. In addition, harvesting and refuse removal may provide sufficient aesthetic benefits (rough fish removal and aquatic vegetation clearing) to be well worth continuous efforts on many lakes.

Lake shores, river frontages and entire drainage basins may require better zoning regulations in order to minimize the introduction of nutrients.

Other methods show promise for specific waters. For example, diversion of effluents around the Madison lakes and flushing waterways with clear water as practiced in Milwaukee and Chicago have improved local conditions. Chemical control of algae and large aquatic plants is effective in localized areas, but it is only a treatment of the symptom and may cause harmful side effects. Dredging shallow portions of lakes, although expensive, may become worthwhile.

Artificial circulation of an entire lake is practical and is now beginning to receive some attention as a means of improving water quality. Continuous vertical mixing and aeration with compressed air to cause accelerated oxidation of plant and animal deposition may provide improved water quality in lakes already in an advanced state of enrichment. Drawing surplus water from the bottom of lakes during seasons when it is richer in nutrients than the surface waters normally spilling out may benefit water quality. The impoundment of streams and subsequent controlled release of water to improve quality shows considerable promise as a control method.

A number of recommendations for coping with the problem of deteriorating water quality from excessive water fertilization follows.

RECOMMENDATIONS

1. Initiate studies on sources of nitrogen and phosphorus to determine their significance in fertilization of Wisconsin water. Particular emphasis should be given to municipal sewage, manure spread on frozen land, drainage from marshes and other wetlands, urban runoff, industrial waste waters, agricultural drainage and septic tanks. These studies should be directed toward determining the expected contribution from these sources in order that better estimates can be made in specific situations.

2. Initiate a study on the significance of detergent-based phosphorus in the fertilization of Wisconsin surface waters. If this study shows that detergents represent a significant source of phosphorus, action should be taken to minimize this source.

3. Initiate studies on methods of controlling plant nutrients from sources that may be of significance. Emphasis should be placed on performance, cost of installation and operation of nutrient removal processes from pilot plants, demonstration units and full scale operating systems. Also, emphasis should be given to methods of zoning watersheds to minimize the transport of plant nutrient to lakes.

4. Initiate long-term detailed studies on the current degree and rate of fertilization of selected lakes and rivers by nitrogen and phosphorus as well as other growth promoting substances and factors. Emphasis in these studies should be directed toward gaining information on the relationships of plant nutrient influx and the growth of excessive amounts of aquatic plants. Streams and lakes that are in various degrees of eutrophication should be selected for study. It is suggested that consideration be given to studies on Trout and Crystal Lakes in Vilas County, Pine Lake in Chippewa County, Big Cedar Lake in Washington County, Devils Lake in Sauk County, Little Court Oreilles Lake in Sawyer County, Lake Minocqua in Oneida County, Lake Delavan in Walworth County, Pewaukee Lake in Waukesha County, Bailey Lake in Waupaca County, Lake Mendota in Dane County, the Brule and Rock Rivers and Black Earth Creek. One or two lakes that have excessive amounts of aquatic plant growth should be selected for a demonstration project in which every feasible effort is made to reduce the amounts of plant nutrients entering the lake. This study would provide information on the cost of minimizing plant nutrients from various sources and also the effect of this action on water quality.

5. Initiate studies on the technology of harvesting or increasing the harvest of surplus crops in lakes and rivers, hence removing fertility, e.g. fish, higher aquatic plants, algae, bog and marsh plants and, possibly, removal of bottom sediments.

6. The State should initiate a program of review of potential water quality problems in proposed public and private impoundments.

7. On the lakes where action is taken to reduce nutrient inflow, studies should be initiated to determine the effect of the corrective action on water quality.

8. An advisory committee consisting of representatives from state agencies and university personnel should be formed to advise, coordinate and guide the studies on the problems of excessive water fertilization.

9. A water fertilization study group should be established. This group should consist of senior individuals and supporting assistants representing aquatic biology, soil chemistry, water chemistry, ground water hydrology, sanitary engineering, political science, planning and water law. The primary responsibility of the group would be to investigate lakes and rivers that are being excessively fertilized in order to determine the sources of plant nutrients, recommend corrective action and determine the effect of these measures.

10. A substantial fund should be allocated to support the investigations listed above.

11. A need exists to keep the public informed concerning problems and progress on excessive fertilization. The University Extension, or another appropriate agency, should undertake this service as a central objective.

I. THE PROBLEM

The "Working Group on Control Techniques and Research on Water Fertilization" has been charged with the problem of excessive fertilization of lakes and streams. It has been suggested that the need for removal of nutrients should be studied to produce a proposed state policy or programs in this field.

There is a general consensus that excessive fertilization is a growing problem and results in a deterioration of water quality. Often the problem is insidious and makes deep inroads before being detected. Over a period of years there may be a gradual loss in clarity, a development of color and an increase in aquatic life with a changed ecological make-up. These are symptoms, yet they could be regarded as "normal" conditions too. Weed choked areas, the stench of decaying algae and fish, curtailment of water sports, losses in property values, water supply taste, odor, and filtration problems and the change from aesthetic values to nuisances can be the cumulative results that bring the matter to a head.

Lakes and quiescent bodies of water appear to be more adversely affected than flowing streams. Fertilization is often associated with man's activities. A systematic approach would be to get an idea of the elements or ingredients that make a water fertile, determine the source or sources and find out what can be done to eliminate, restrict or ameliorate them.

II. NUTRIENTS FOR CONSIDERATION

Bartsch (1961) gave examples of induced eutrophication of surface waters made fertile by sewage and included fish ponds, Lake Zurich in Switzerland, the Madison lakes, Connecticut's Lake Zoar and Lake Washington at Seattle. Bare Lake, Alaska, was deliberately fertilized (Edmondson, 1964) with .025 mg/l of PO_4-P and 0.125 mg/l of NO_3-N. This was followed by a heavy algal growth and its cloudy appearance was noted by airplane pilots.

A report by Rudolfs and Heinemann (1938) called attention to the fact that the value of sewage and sludge in the promotion of plant growth could not be attributed to their mineral nutrients only. They stated that practically all the experimental work was with nitrogen, phosphorus, potash and mineral substances. Provasoli (1961) indicated that vitamins B_{12}, thiamine, and biotin and perhaps other unknown substances should not be neglected as factors in bloom production. Most investigations of aquatic nutrients center about nitrogen and phosphorus. Undoubtedly, these two are critical but other factors are apparently involved.

The usual nitrogens considered are those tied up in cell material as organic nitrogen, and the inorganic forms: Ammonia, NH_3, or ammonium, NH_4^+; nitrite, NO_2^-; and nitrate, NO_3^-. Inorganic nitrogens are considered as readily available nutrients. Free nitrogen gas, N_2, is generally not available but in some cases can be significant where nitrogen fixation organisms are involved.

Soluble orthophosphate, PO_4^{-3}, is considered the important form insofar as cell utilization is concerned. This type of phosphorus is sometimes loosely referred to as soluble phosphorus or inorganic phosphorus. However, condensed or polyphosphates, major constituents of synthetic detergents, are soluble and inorganic but are not orthophosphates. Total phosphorus includes the condensed phosphates and orthophosphates as well as that found in organic forms.

III. NUTRIENT SOURCES

Sewage

Sewage is frequently cited as being a major contributor to water fertilization. It would be helpful to get an idea of the amounts involved and nutrient removals that are obtainable by present treatment practices.

A report by Rudolfs (1947) indicates an adult ingests from 1.2 to 2.0 grams of phosphorus per day (1 to 1-2/3 lbs./year). In adult humans, it can be assumed that over-all the input equals the output. In the excreta, 35 to 50 percent of the phosphorus is contained in the feces and 50 to 65 percent is discharged in urine. Phosphorus in the latter is present in oxidized form as free phosphoric acid and disodium and monosodium phosphate. An adult needs a minimum of 0.88 grams of phosphorus per day (0.71 lbs./year) to replace body losses (Wirtshafter, 1942). Pregnant women, nursing mothers and growing children need about 1.3 to 1.5 grams of phosphorus per day (1.05 to 1.20 lbs./ year).

Data presented by Keefer (1940) concerned nitrogen and phosphorus in fresh human wastes from 100,000 persons of both sexes and varied ages and showed an average excrement per day of 82.5 grams of feces and 967 grams of urine. The daily average amounts of nitrogen and phosphorus amounted to 6.63 and 0.81 grams respectively (5.3 and 0.65 lbs./year) with 87 percent of the nitrogen and 64 percent of the phosphorus discharged in the urine. The study dates back before the turn of the century. Analytical methods used then (Rafter, 1894) are still valid but diets may have altered the make-up of excreta somewhat.

Buswell (1928) compiled data from physiological chemistry texts by Hawk and Mathews showing the nitrogen excreted by a normal adult per day. The urine contribution amounted to 1,500 cubic centimeters containing 17.57 grams of nitrogen while there was 1.80 grams in the feces. Following is the amount of nitrogen in grams per day from various constituents in the urine.

Urea	-	16.35	Hippuric Acid	-	0.05
Creatinine	-	0.37	Ammonia	-	0.53
Uric Acid	-	0.25	Thiocyanates	-	0.02

There was no breakdown of the nitrogen compounds in the 20 grams dry weight of feces excreted per day. The total nitrogen excreted per day by a normal adult is given as 19.37 grams (15.6 lbs./year).

In addition to excreta, domestic wastes contain kitchen and laundry wastes. Also, the water supply or carriage water may contain some nutrients initially. Undoubtedly, comminuted household garbage adds to the nutrient loading, but citable figures seem to be lacking.

Data on public water supplies in Wisconsin are shown in a 1935 compilation (Bur. San. Eng., 1935). Of the 467 public water supplies listed 201 had nitrate-N of less than 0.1 mg/l, 89 were in the range from 0.1 to 0.5, 84 ranged from 0.6 to 2.0, 74 had concentrations from 2.1 to 5.0 and 19 had values exceeding 5 mg/l. The arithmetic average was approximately 1.2 mg/l. In only two cases was the nitrite-N concentration in excess of 0.1 mg/l. Twenty-seven of the supplies were from surface waters and the remainder from wells and springs. The highest nitrogen concentration believed found in tests of Wisconsin private water supplies was 150 mg/l of nitrate-N from a well located near a corral (Nichols, 1966). In the summer of 1966 a farmyard well showed a content of 100 mg/l of nitrate-N (Goode, 1966). The soluble phosphorus content of 104 Wisconsin well waters (Hensel, 1937) varied from 0.00 to 0.15 mg/l. The majority of samples contained less than 0.01 mg/l. [1 mg/l in 100 gals./day = 0.378 grams/day or 0.304 lbs./year.]

Sawyer (1960) found that prior to the use of synthetic detergents, phosphorus in sewage ranged from about 2.5 to 4 mg/l and averaged 1.5 grams per person per day (1.2 lbs./year). He also indicated that heavy duty detergents may contain 12 to 13 percent of phosphorus.

Industry statistics for 1963 (U. S. Bur. Census, 1966) indicate the total production of synthetic organic detergents for household use as follows.

Dry Types	-	3,152,840,000 lbs.
Scouring Cleansers	-	508,295,000 lbs.
Liquids	-	127,523,000 gals.

During 1963, the principal phosphorus compounds and the amounts used in soap and detergent products was given as 696,197 tons of sodium tripolyphosphate and 109,209 tons of tetrasodium phosphate. Figures were not available for the 1963 use of trisodium phosphate, although in 1958 the latter amounted to 30,776 tons. Calculations based on the amount of phosphorus in these compounds for the July 1963 population show that the average per capita use in soaps and other detergents averaged 2.2 pounds per person per year (2.73 grams/day).

A recent report on phosphorus chemicals (Sherman, 1966) showed the 1965 production as 550,138 tons of elemental phosphorus, 56 percent of which was used by the detergent industry. It was stated that the amount of phosphorus in most detergents has been increased during the past few years. Dividing the 616,000,000 pounds of phosphorus involved by the July 1, 1965 estimated United States population of 194,583,000 results in a per capita phosphorus usage in detergents of 3.17 pounds per year (3.94 grams per day).

A graphical presentation (Carmody, 1965) shows that the United States demand for synthetic detergents increased from about ½ billion pounds in 1948 to 4 billion pounds in 1964, while the use of soap decreased from 2½ to 1 billion pounds in the same period. Maloney (1966) demonstrated that a common household detergent stimulated algal growth because of its sodium triphosphate, $Na_5P_3O_{10}$, ingredient.

About 25 municipalities in Wisconsin using ground water add polyphosphate to sequester iron or control corrosion. The maximum concentration of polyphosphate additive that will be approved for use is 10 mg/l and dosages are usually less than half that amount. Based on an average water usage of 100 gallons per day and a phosphate concentration of 4 mg/l, it is estimated that the carriage water contribution from this source amounts to about 0.4 pounds per person per year. At Milwaukee, ammonia or ammonium sulfate are used to aid in disinfection of water but the concentration of nitrogen amounts to only about 0.2 mg/l and is negligible in the over-all sewage make-up.

According to the report by Rudolfs (1947), 50 to 60 percent of the phosphorus in raw sewage is removed by settling, 75 to 80 percent by settling and trickling filter, and 80 to 90 percent by the activated sludge process while irrigation achieved approximately a 95 percent removal. These values for conventional treatment facilities are higher than presently being achieved.

Chicago area activated sludge type treatment plants (Hurwitz, 1965) remove an average of 66 percent of the total phosphorus with individual plant removals of 78, 37 and 54 percent being found. The authors indicated that variations were probably because of the existing characteristics of the wastes received at the plants. Orthophosphate appeared to be more difficult to remove than other forms of phosphorus.

Studies on three activated sludge plants in San Antonio, Texas (Vacker, 1966), disclosed a considerable variation in phosphate removals from practically nothing at the "underloaded" Leon Creek plant to as much as 96 percent in the Rilling plant, with up to 6.8 percent of phosphorus on a dry weight basis being found in the sludge. The apparent design and operational considerations for maximum phosphate removals follow.

1. Maintain a constant BOD to solids loading rate of about 50 pounds of BOD/100 pounds of aeration solids by controlling raw waste and return sludge but avoiding long retention in the secondary clarifier.

2. Provide a relatively large amount of air, but avoid over-aeration which would result in excessive nitrification and aerobic digestion of solids.

3. Digester liquors should not be returned to the treatment system until the phosphates are removed from the liquor.

The authors felt that the considerations were "compatible with economical and efficient treatment for removal of BOD and suspended solids."

The Milwaukee Metropolitan Sewerage Commission (Milwaukee Sew. Comm., 1965) (Ernest, 1966) operates a conventional activated sludge plant for treatment of screened sewage. Waste sludge is dried for fertilizer and is not digested. Detailed plant records are available. During 1965, the screened sewage contained an average of 39.6 mg/l of nitrogen and 7.7 mg/l of phosphorus. Effluent analyses showed that treatment removed 69.9 percent of the nitrogen and 75.3 percent of the phosphorus. The sludge contained 44.7 percent of the incoming nitrogen and the remaining 25.2 percent probably represents loss to the atmosphere by denitrification and aeration. Phosphorus calculations agree within 5 percent when comparing the influent with effluent plus sludge, the latter figure being slightly higher. The treatment plant has a split flow. In August 1965, following completion of changing the east section from spiral flow tube diffusors to ridge and furrow plate type diffusors, the over-all removal of phosphorus increased to about 80 percent. The Commission staff has been studying nutrient removals, particularly of the phosphorus, and conducted plant-size experiments. Detailed, full-scale nutrient studies would be beneficial to all, and federal or state financing of such projects should be considered.

The Madison Metropolitan Sewerage Treatment Plant (Woodburn et al., 1965) (Baillie, 1966) operates parallel facilities of the trickling filter and activated sludge types to treat settled sewage. In 1965, 72.3 percent of the flow was treated by activated sludge; 26.8 percent received trickling filter type. Sludge is digested and then air-dried. During 1965, the average nitrogen concentration in the raw sewage was 29.4 mg/l and the discharge composite from both plants amounted to 20.9 mg/l for an over-all reduction of 28.9 percent. Phosphorus determinations are not routinely made on the raw sewage. Following is a comparison of the effluent from Madison's Nine-Springs Sewage Treatment Plant for a one year period in 1943-44 by Sawyer and Associates (Sawyer, 1943) and on a calendar basis for 6 years, 1960-65, in a recent study (Wis. Water Poll., 1966).

Madison's Treated Effluent

Year	Org. N	Inorg. N	Total P	Sol. P
1943-44	2.4	17.1	3.20	2.84
1960	4.45 ± 1.30	18.63 ± 2.27	9.26 ± 1.17	6.91 ± .84
1961	4.87 ± .62	20.67 ± 1.76	11.02 ± 1.08	7.94 ± .88
1962	6.18 ± .91	20.82 ± 2.38	11.91 ± .94	8.44 ± .51
1963	5.75 ± .66	21.15 ± 1.59	9.72 ± 1.19	8.12 ± .79
1964	2.95 ± .92	16.92 ± 3.21	9.07 ± 1.06	7.95 ± .88
1965	3.36 ± 1.58	17.53 ± 1.83	7.63 ± 1.08	6.69 ± .77

The above results are averages based on 24-hour composites taken about once a month. Data for 1960 through 1965 include 95 percent confidence intervals for the means. Assuming that the standard deviation of the 1943-44 mean values are similar to those found for the recent years, a statistical evaluation indicates nitrogen values in 1965 were similar to those of 1943-44 but differences are noted for 1961 through 1963. Phosphorus results are sharply and very significantly higher than in the earlier period but show a decrease in the past year. Flow in 1965 averaged about 22.48 million gallons per day (MGD) compared with 12.5 MGD in the 1943-44 period. The sewage volume in 1965 was 5.9 percent higher than in 1964, and if this was caused by ground water dilution would lessen the phosphorus discrepancy. Other possibilities could include a change in the make-up of domestic sewage or industrial waste contributions or in the sampling and analysis procedures.

Additional treatment facilities were placed into operation in September of 1963. The plant overload for the period from 1961 through 1963 probably accounted for the high nitrogen. Phosphorus increases over the earlier period are probably due to the use of synthetic detergents, but there is no apparent reason for last year's decrease. Three sets of composite samples on the plant were obtained in May of 1966. Their averages revealed a concentration of 10.5 mg/l of total phosphorus in the raw and 7.6 mg/l in the effluent for an over-all reduction of 27 percent. The soluble phosphorus was reduced from 8.6 to 6.7 mg/l or about 22 percent.

Sewage from the Village of Dickeyville, Wisconsin, is treated by an extended aeration type activated sludge system. Waste sludge is hauled and disposed of onto land. Following are the results in mg/l obtained on three surveys.

	9/14-15/65	9/15-16/65	2/16-17/66
BOD			
Raw	340	268	454
Final	2.6	2.8	23.4
% Reduction	99.2	99.0	94.8
Nitrogens (Untreated Sewage)			
Organic	18.0	21.4	28.0
Ammonia	49.0	53.2	56
Nitrite	<0.002	<0.002	<.004
Nitrate	<0.4	<0.80	0
Total	67	75	84
Nitrogens (Treated Sewage)			
Organic	1.4	0.82	4.8
Ammonia	0.44	0.37	3.6
Nitrite	0.16	0.008	0.55
Nitrate	32.4	31.8	35.6
Total	34.4	33.0	44.6
% Reduction	48.7	56.0	46.9
Phosphorus			
Total Raw	17.0	21.0	22.3
Sol. Raw	12.0	14.0	11.0
Total Treated	16.3	16.5	17.0
Sol. Treated	15.4	15.0	14.7
% Reduction	4.1	21.4	23.8

The plant receives excellent operating attention and the loading and flow are substantially less than the plant was designed to handle. Per capita waste volume in this community is low, less than 45 gallons per day during the surveys, which helps account for the high nitrogen and phosphorus content in the raw sewage. The effluent is highly oxidized as shown by its low BOD and high nitrates. However, the treatment removes only about 50 percent of the nitrogen and 20 percent of the phosphorus. Note too that in all cases the soluble phosphorus concentration in the effluent was higher than that in the untreated sewage.

Another similar extended aeration-type plant serves the Wrightstown Sanitary District #1 to handle domestic sewage from the unincorporated community of Greenleaf, but it is followed by a flow-through stabilization pond. The results for a single 24-hour survey in April 1966 follow.

	Raw	Plant Effluent	Lagoon Effluent
Nitrate - N	1.6	11.5	3.5
Total P	9.2	4.8	2.8
Soluble P	2.4	4.0	1.8

Unfortunately only the nitrate portion of the nitrogen was determined. The plant was handling about 70 percent of its design flow during the survey and the theoretical pond detention was 50 days. A little less than 50 percent removal of phosphorus was achieved by the plant, but the over-all reduction by the plant and lagoon was approximately 70 percent.

A survey of the conventional activated sludge plant at Kimberly in March 1966 showed that the total phosphorus was reduced from 18.7 to 13.3 mg/l or about 29 percent, but the treatment increased soluble phosphorus from 3.3 to 3.7 mg/l. The nitrate-N concentration in the effluent was 4.3 mg/l compared with less than 0.08 in the influent. No further nitrogen data was available. This plant has sludge digestion facilities. A survey of a conventional activated sludge plant at an institution in May 1966 showed nitrogen concentrations of 23.3 and 17.4 mg/l in the raw and final for an over-all removal of 23 percent. Total phosphorus was reduced from 3.8 to 2.4 mg/l or 37 percent, while soluble phosphorus changed only from 1.6 to 1.4 mg/l or a reduction of only 12.5 percent.

The Village of Little Chute has a modified activated sludge plant consisting of pre-aeration, contact aeration, sludge reaeration and aerobic sludge digestion. A single survey indicated a reduction in nitrogen from 20.9 to 18.0 mg/l or 16 percent and an apparent increase in total phosphorus from 7.6 in the raw to 8.0 mg/l in the final. Soluble phosphorus in the final was also higher than in the raw sewage.

Nutrient contributions from the Woodruff Sewage Treatment Plant were studied beginning in about 1942. At that time, the community had a high-rate filter and sludge digestion facilities. Composite samples of influent and effluent were taken for five surveys between December 1942 and February 1943. The average nitrogen and phosphorus concentrations reaching the plant then amounted to 55.3 and 4.43 mg/l respectively, compared with 30.7 and 2.53 mg/l in the effluent. Over-all reductions amounted to 44.5 percent of the nitrogen and 43.6 percent of the phosphorus. In May 1966 a study was made of a high-rate filter plant treating sanitary wastes from an industrial establishment. Nitrogens were reduced from 39.6 to 29.9 mg/l and the total phosphorus decreased from 8.4 to 7.0 mg/l. Respective reductions amounted to 24.4 and 16.6 percent. The soluble phosphorus increased from 4.2 to 4.8 mg/l, but the plant's BOD reduction amounted to 80 percent which is about par for this type of facility.

Two high schools in southeastern Wisconsin use septic tanks and sand filters. Results obtained in mg/l on composite samples in May 1966 follow.

	New Berlin 5-4	Brookfield 5-4	New Berlin 5-24
Septic tank Effluent			
Organic N	9.3	11.3	7.8
Ammonia	42.4	25.2	44.8
Nitrites	<.01	<.002	<.002
Nitrates	.32	<.16	<.4
Total N	52.0	36.7	53.0
Total P	6.4	4.8	8.0
Soluble P	4.8	2.8	8.0
Sand Filter Effluent			
Organic N	2.4	1.0	0.9
Ammonia	4.8	<.1	9.6
Nitrites	.34	<.01	.38
Nitrates	17.6	13.0	15.2
Total N	25.2	14.1	25.9
Total P	2.2	2.4	2.4
Soluble P	2.2	2.2	2.0
% N Reduction	51.5	61.7	51.1
% P Reduction	65.7	54.2	70.0

The reductions are based on comparisons of septic tank effluent with the sand filter effluent because of difficulties in sampling the raw sewage at these locations. However, on May 24, samples of raw sewage were obtained at the New Berlin High School. They revealed 54.6 and 15.6 mg/l of organic and ammonium nitrogen and 7.6 and 4.8 mg/l of total and soluble phosphorus. This would indicate the septic tank removed about 17 mg/l of nitrogen, but there was an apparent increase in the phosphorus of 0.4 mg/l which could be attributable to the inability of obtaining a representative sample.

Mackenthun and McNabb (1961) reported on a study of sewage stabilization ponds in Wisconsin. At Junction City, the over-all reduction for the two lagoons operated in series was in excess of 90 percent for nitrogen and phosphorus on three of the four composite samplings. However, tests in March 1959 indicated a reduction of 45.7 percent and 8.2 percent for the nitrogen and phosphorus. In August 1958 the Spooner lagoon showed a nitrogen reduction of 80.7 percent and a phosphorus removal of 71 percent. The previous December, a nitrogen reduction of 67.2 percent was achieved. The tests in December did not include an analysis for phosphorus.

In 1953, the California Water Pollution Control Board reported on water reclamation investigations (Cal. Water Poll. Bd., 1953). A total of eight circular spreading basins were constructed adjacent to the Lodi, California, Sewage Treatment Plant. The study was made with fresh water, final effluent and settled sewage on a Hanford fine sandy-loam with a water table of at least 22 feet. Ammonia-N was completely removed within 4 feet. Nitrites disappeared but nitrates increased by several hundred percent. Phosphates disappeared during the first foot of vertical water travel.

An investigation of nitrogen ground water contamination in Minnesota (Preul, 1966) was made during the years of 1962-65 from observations at 11 waste stabilization ponds and 6 soil absorption systems. Effluents from septic tanks had average dissolved nitrogen concentrations of about 60 mg/l mainly as NH_4-N. Conversion of ammonium to nitrates in soil to as much as 40 mg/l of NO_3-N were found, and, in one case, a concentration of 28 mg/l was found at a distance of about a hundred feet. Raw sewage discharged to the stabilization ponds under consideration contained a dissolved nitrogen average of 25 mg/l. In the soil, ammonia was found to be less than 3 mg/l within 20 feet and nitrates did not exceed 1.0 mg/l at 150 feet. The tie-up of nitrogen in algal cells and anaerobic conditions on the pond bottom was believed to lessen the travel of nitrogen in the soil. Stabilization ponds did not appear to present a serious threat to nitrate contamination of ground waters.

A study (Anon., 1966) was summarized in the Journal of Water Pollution Control Federation concerning irrigation of treated sewage at the Pennsylvania State University, University Park, Pennsylvania. Spray irrigation was used year-around to dispose of 0.5 MGD. It is reported that 68 to 82 percent of the nitrogen and 98 to 99 percent of the phosphorus contained in the treated plant effluent is filtered out in the upper 12 inches of soil.

Santee is a residential community with a population of 13,000 located near San Diego. Reclaimed water (sewage) is used as a water source for a series of 30 acres of lakes. These lakes are used recreationally for boating, swimming and fishing. Sewage is treated by an activated sludge-type system and a 30-day storage oxidation pond. Pond effluent is pumped to 6 one-half acre percolation beds underlain by impermeable material at a depth of about 10 feet. Underground flow is collected, chlorinated and flows consecutively to lakes 5, 4, 3 and 2. Nutrient amounts and reductions are shown in the following table.

	N(lbs./day)	% Red.	P(lbs./day)	% Red.
Community Wash Water	450		150	
Treatment Plant Effluent	310	31.1	62	58.7
Oxidation Pond Effluent	160	54.4	52	65.3
	78	82.7	26	82.7
Infiltration System Effl.	7	98.7	1.4	99.1

The 7 pounds per day of nitrogen is equivalent to 2 to 3 mg/l, while the phosphorus concentration amounts to about 1/5 of the nitrogen or 0.4 to 0.6 mg/l. A nutrient balance of lakes 4 and 3 follow.

	Lake 4		Lake 3	
	N(lbs./yr.)	P(lbs./yr.)	N(lbs./yr.)	P(lbs./yr.)
Inflow	2,260	440	690	150
Outflow	690	150	290	25
Loss	70	50	50	10
Stored	1,500	240	350	115

Shad, bass, catfish and sunfish were planted in 1961 and 1962. Excepting the channel catfish, there are indications of successful hatches. Eutrophication is apparent. Blooms develop, but as yet have not been repulsive. Two fish kills were experienced in 1965 as a result of oxygen depletion when the predominant growths were blue-green algae. In the deeper regions of the pond, the sediment has formed a thick layer of sulfurous muck (Merrill, 1966).

Aside from land disposal facilities and Milwaukee's Jones Island treatment plant, conventional biological sewage treatment plants in Wisconsin are removing less than one-half of the nutrients. Absence of primary settling and sludge digestion at the Milwaukee plant, as well as use of ferric chloride for sludge conditioning, may have something to do with that plant's superior nutrient removals. Some treatment plants doing an excellent job of BOD removal have mineralized the bulk of the nutrients to nitrates and orthophosphates which are readily available fertilizers. Disturbing also is the fact that present phosphorus removals are considerably lower than those shown in the report by Rudolfs (1947) which means that the doubling of the phosphorus in the raw sewage has resulted in a substantially higher concentration in the effluent. If population increases are also considered, the phosphorus picture is bleak indeed.

Another portion of the report discusses the high nutrient removals that can be achieved on a laboratory scale and some of the problems involved. Brief mentions have been made recently that nutrient removals of 90 percent and better are being achieved at some treatment plants. Authoritative studies and papers regarding these relatively high nutrient removals are lacking. Particularly needed are detailed studies concerning successful plants and the development of the more promising bench experiments to full-scale facilities. On a practical scale at the present time, about the best we have to offer are land disposal facilities.

Per capita plant construction costs decrease with increasing treatment facility size and generally the larger facilities provide consistently better treatment and result in economies of operation. Metropolitan treatment works are in a more favorable position to attract and retain good personnel. Another portion of the report indicates that sewage has a high phosphorus content compared to its nitrogen and carbon biochemical requirements. Inclusion of industrial wastes that have a relatively high carbohydrate to nutrient content could be mutually advantageous.

Private disposal systems are of the outdoor privy and the septic tank-soil absorption types. Use of the outdoor facility is generally confined to excreta disposal, while water-borne wastes treated by the other usually include kitchen and laundry wastes. A few of the outdoor privies have a concrete vault, but most of the pits have earthen bottoms and sides and there is absorption of liquid into the ground. The outdoor system has an advantage insofar as confining the nutrients, but convenience as well as sanitary and aesthetic considerations are contributing to its demise. Soil absorption systems, as the name implies, require a soil that will transmit water. Septic tank pre-treatment to remove solids and grease, suitable soil, adequate sizing, etc., are factors that must be taken into consideration.

Industrial Wastes

There is considerable variation in the nutrient concentrations found in industrial wastes. Some industrial wastes, such as those from most pulp and paper mills, require supplementary nutrients to make them amenable to biological treatment. Other wastes may be high in nutrients but be unbalanced with respect to the C-N-P ratios. Also there may be a considerable variation from factory to factory within an industry, depending on inplant operations and controls.

Typically, paper and pulping wastes are low in nutrients. However, two of Wisconsin's pulp mills use the ammonium sulfite cooking process. These wastes could represent a source of nitrogen but information on the concentration and over-all contribution is lacking.

A study was made by the University of Wisconsin, under contract with the U. S. Department of Agriculture, regarding the effectiveness of spray irrigation for the disposal of dairy plant wastes. A series of composite samples were obtained of the wastes being discharged at the five factories which were intensively studied, and the following results were reported.

	Nitrogen (mg/l)		Phosphorus (mg/l)	
Plant	Ave.	Range	Ave.	Range
A	-	-	17.1	6.5-27
B	180	108-298	59.7	24-105
C	43	10-111	31	12-77
D	170	93-319	132.3	33-194
E	58	19-110	35.2	16-62

This study indicated that under suitable conditions, spray irrigation provided a satisfactory method of dairy waste disposal (Lawton et al., 1960).

Sharratt et al. (1959) found an average of 1,364 mg/l of nitrogen and 450 ppm of phosphorus in seven Swiss and American cheese whey samples. Their study indicated that whey could be used as a source of plant nutrients with favorable effect on soil aggregation. Composite samples were obtained at two creamery plants in Wisconsin by pollution control personnel. At a small factory manufacturing some butter and shipping whole, skim and buttermilk , the nitrogen and phosphorus concentrations were 6.7 and 6.0 mg/l, respectively. At a large plant manufacturing butter from whey cream, producing buttermilk solids and practicing water reuse, the nitrogen and phosphorus amounted to 114.4 and 30.5 mg/l. Both of these factories used irrigation disposal, and there generally was little evidence of wastes overflowing to a stream.

Canham (1958) made a study of spray irrigated pea canning wastes containing comminuted solids and reported the nutrients in pounds per acre for a seasonal application of 7 inches of waste water.

Nutrient	Screened Wastes	Comminuted Solids	Total
N	12.8	7.3	20.1
P	9.8	4.1	13.9
K	28.7	8.2	36.9

The total nutrients added to the land were said to be considerably greater than what was removed from the soil by a crop of meadow fescue. Calculations on the above data show that the average nitrogen and phosphorus concentration in screened pea canning wastes amounted to 8.1 and 6.2 mg/l, and if the comminuted solids were added the respective concentrations would be 12.7 and 8.8 mg/l.

The Oscar Mayer Company meat packing plant at Madison, Wisconsin provides secondary treatment of their wastes before discharge either to the Madison Metropolitan sewerage system or to the irrigation fields for additional treatment. Lysimeter studies were conducted over a 10-year period from 1950 to 1959, and the nutrients in the secondary treated waste waters averaged 36.8 mg/l of nitrogen and 9.6 mg/l of phosphorus. Soil, crop and percolate samples indicated nearly a complete removal of the phosphorus and about 90 percent of the nitrogen. Investigations on 30-foot by 40-foot plots, using Miami silt loam and Plainfield sand, were made over a four-year period. The total nitrogen and phosphorus concentrations in the effluent irrigated were 54 and 20.3 mg/l, respectively. Percolate from the Miami silt loam had 9.0 and 9.5 mg/l of total nitrogen and 0.6 and 0.8 mg/l of total phosphorus at optimum and high effluent applications. The effluent from the Plainfield sand plot had 73.0 and 102.5 mg/l of total nitrogen and 1.0 and 1.2 mg/l of total phosphorus. All nitrogen in the effluent was nitrate. The extremely high nitrogen was believed due to concentrating of the percolate by evaporation and transpiration and also because of "soil disturbance" in setting up the plots (Seesing, 1961).

Wastes from a small laundry in Soldiers Grove, Wisconsin, are treated with alum and settled. Purpose of treatment is to remove BOD, suspended solids and detergents. However, on two occasions in 1966, the concentration of phosphorus was determined to get an idea of the removal being achieved. Results are shown in the following table.

	Raw		Treated	
Date	Total P	Soluble P	Total P	Soluble P
4-27	80	6.4	12.4	0.1
7-20	80	5.4	14.0	0.7

The above data indicate a phosphorus removal of slightly over 80 percent.

The use of nitrates for waste stabilization (Warrick, 1945) may not add to the nitrogen concentration in the effluent. Nitrogen balances on cannery lagoons treated with sodium nitrate showed a rapid breakdown of the nitrate to gaseous nitrogen and possibly, at times, to ammonia with an over-all loss of nitrogen. Observations and samplings were made at a milk receiving station (Ernest, 1954) where waste treatment was provided by a nitrate dosed four-compartment septic tank. A total of 100 pounds per day was dissolved and uniformly added to the milk wastes resulting in an average nitrate-N addition of about 550 mg/l. The results obtained on composite samples indicated the first compartment effluent contained only 0.5 mg/l of nitrate-N, 15.2 mg/l of nitrite-N, with the remaining 42.7 mg/l of nitrogen mainly in the organic form. The fourth compartment effluent contained little if any nitrates and nitrites, 16.8 mg/l of ammonia-N and 26.0 mg/l of organic nitrogen. A large volume of gas, probably nitrogen, was evolved from the first two compartments.

Aside from the irrigation studies, there is relatively little data in depth available on the degree of nutrient removal obtained by treatment of industrial wastes. It is anticipated that for balanced industrial wastes, nutrient removals would be comparable to those achieved by similar type sewage treatment facilities.

Contributions from Rural Lands

Most of the soluble nutrients which get into lakes and streams from rural areas are first dissolved in water and then moved in solution to the waterways. Some nutrients may also be carried to the streams and lakes as components of suspended particulate matter and later be converted to soluble forms. Therefore, to fully grasp the problem of water fertilization from rural lands, it is necessary to understand the factors which affect the forms and solubilities of the nutrients and the manner in which the nutrients are transported to the streams and lakes. Since most of this transportation occurs in surface runoff or in percolating water, a knowledge of the factors affecting the relative amounts of runoff and percolate is important.

The Water Balance in Wisconsin

The State of Wisconsin receives an average precipitation of about 30 inches per year. Part of this is intercepted by the vegetation and is evaporated without reaching the ground. Of that which falls on the land, some will run off the surface and the remainder will infiltrate into the soil. Of that which infiltrates, some will be lost by evaporation from soil and plant surfaces (evapotranspiration) and some will percolate through to the ground water. The problem of water fertilization is concerned primarily with the nutrients in the surface runoff which get to streams by overland flow and nutrients in percolating waters which move slowly to the waterways as "base flow."

Factors Affecting Surface Runoff. Surface runoff occurs whenever the rate of precipitation exceeds the rate of infiltration. There are many factors including soil texture, slope, moisture content, cover, etc., which affect infiltration into a soil, but one of the most important is the physical character of the soil surface. If many large pores are present at the soil surface, water will infiltrate rapidly providing there is no impervious layer in the soil below. The presence of large pores is usually associated with either coarse-textured sandy soils or with well-aggregated fine-textured soils. The large pores at the surface must be maintained if continued rapid infiltration is desired. This may not be a problem with sandy soils, but the maintenance of stable aggregates at the surface of fine-textured soils can be difficult.

The energy associated with the impact of falling raindrops is one of the most important factors operating to break down the soil aggregates. Any cover which will absorb the raindrop impact will tend to protect the surface structure, thereby maintaining infiltration with resulting low runoff. Forested lands, because of their extensive surface cover, generally show the least and agricultural soils planted to row crops the greatest surface runoff when soil and slope conditions are otherwise equivalent. The surface runoff that does occur from forested lands usually takes place in the spring when the snow is melting and when some of the soil may still be frozen. The surface runoff from agricultural lands will usually range from 1 to 2 inches per acre per year in southern Wisconsin, but there can be considerable variability from year to year depending on the amount and seasonal distribution of the precipitation and on the rainfall intensity during the more severe storms.

Factors Affecting Percolation of Water. The water which infiltrates into the soil ultimately is evaporated or transpired, or it percolates to the ground water. The amount reaching the ground water depends on a number of factors, most of them related to the conditions affecting evapotranspiration. For evapotranspiration to occur there are two prerequisites, a source of energy (vaporization of 1 gram of water requires about 580 calories) and a source of water. The energy is derived primarily from solar radiation. In an average year, Madison, Wisconsin receives enough solar radiation to evaporate about 79 inches of water. Most of this radiant energy, enough to evaporate about 50 inches of water, is reflected or reradiated. The difference or "net radiation" available for evaporation of water or heating the air and soil amounts to enough energy to evaporate about 29 inches of water. This energy, plus about a 2-inch evaporation equivalent derived from dry air masses moving in from other areas, results in an evaporation potential of about 31 inches (Tanner, 1966).

Evaporation from a free water surface, such as a lake, will approximately equal the evaporation potential of 31 inches. Evapotranspiration from land surfaces will depend on the availability of water at the surface exposed to the radiation. If a bare soil is moist at the surface, the actual evaporation will approach the potential evaporation. However, continued evaporation requires that water be transmitted to the surface from deeper in the soil by unsaturated flow. Since the rate of water transfer under unsaturated conditions slows markedly with a decrease in water content in the soil, the rate of evaporation soon exceeds the rate of transmission to the surface and the surface of the soil dries out. At this point further movement of water to the surface is extremely slow, and evaporation practically ceases until the soil is again wet by rain or irrigation.

If plants are growing on the soil, the water supply available for evapotranspiration will be larger. Transpiration from leaf surfaces of plants well supplied with water will approach the potential evapotranspiration, and the water supply available for transpiration will include any plant-available water within the root zone of the plants. Thus the water available to the plant will depend on the content of plant-available water in the soil, the depth of the root system, the distribution of roots within the root zone, and, of course, the replenishment of the supply by precipitation or irrigation. How much this water supply will be depleted during the growing season will depend on the deficit between precipitation and evapotranspiration during that period of time. In some cases, the plant may exhaust the available water in the root zone, and transpiration will be markedly retarded.

In Wisconsin, the potential evapotranspiration approximately equals the precipitation. However, potential evapotranspiration exceeds precipitation by about 7 inches from April through August while precipitation exceeds evapotranspiration by about 6 inches from September through March (see Table 1).

Table 1. Average annual precipitation and potential evapotranspiration by month at Madison Wisconsin.

Time Period	Precipitation Inches	Potential Evapotranspiration Inches	Water Balance Inches	Cumulative Water Balance Inches
Preceding Year	(Assume excess from September on has accumulated.)			4.0
January	1.3	0.2	1.1	5.1
February	1.1	0.5	0.6	5.7
March	1.8	1.3	0.5	6.2
April	2.5	2.9	-0.4	5.8
May	3.3	4.2	-0.9	4.9
June	4.0	5.4	-1.4	3.5
July	3.3	5.9	-2.6	0.9
August	2.9	4.5	-1.6	-0.7
September	4.0	3.2	0.8	0.1
October	2.1	1.8	0.3	0.4
November	2.3	0.6	1.7	2.1
December	1.4	0.2	1.2	3.3
Annual	30.0	30.7	-0.7	
April thru Aug.	16.0	22.9	-6.9	
Sept. thru March	14.0	7.8	6.2	

Thus in an average year up to 7 inches of available water would have to be stored in the soil within reach of the plant roots in order that plants with long growing seasons and complete ground cover would not suffer for lack of water. Conversely, 7 inches of water would be required to replace the moisture deficit in the soil at the end of the growing season before any water could percolate to the ground water. Under the conditions of maximum evapotranspiration described here, there would be no water available to replenish the ground water since the excess water accumulated from September to April does not quite equal the growing season deficit. It should be kept in mind that these are average values, and that actual values, especially for precipitation, vary considerably from year to year.

It is apparent from the above discussion that the proportion of precipitation used for evapotranspiration depends on the characteristics of the vegetation and of the soil. Evapotranspiration is greater.

1. The greater the proportion of the land covered by vegetation
2. The deeper the root system of the plants
3. The greater the proliferation of roots within the root zone
4. The longer the growing season of the plants
5. The greater the amount of water stored within the root zone or within the surface layer susceptible to evaporation
6. The greater the proportion of the rainfall coming as frequent small showers during the months with high potential evapotranspiration.

Once these principles are understood, the reasons for the differences in evapotranspiration under the different land uses shown in Table 2 are apparent.

Table 2. Effect of land use on evapotranspiration (Tanner, 1966).

Type of Surface Cover or Land Use	Evapotranspiration (In./Yr.)
Water	29-32
Forest	25-30
Alfalfa-brome	22-26
Corn	18-22
Grain (seeded to alfalfa)	18-22
Bluegrass	15-19
Bare soil	12-18

In any given watershed the land use will be somewhat varied, and the average annual evapotranspiration will range somewhere between the 12 to 18 inches for bare soil and the 25 to 30 inches for forest. In the Lake Mendota watershed, for instance, the available data indicate that in an average year about 24 inches of water are lost by evapotranspiration and about 6 inches of water finds its way to the surface waters, nearly 2 inches by surface runoff and 4 inches by percolation and base flow. Practically no water is lost from this basin by underflow. The ratio of surface runoff to percolation will vary with slope, ground cover and soil type, so that these data do not necessarily apply to other watersheds.

Soil Chemistry of Nitrogen and Phosphorus

The nutrients of primary concern in surface runoff or percolating water are nitrogen and phosphorus since they appear to be limiting factors for the growth of algae. To understand how these nutrients get from the land into the surface waters, it is necessary to know some of the reactions which affect their solubility.

Nitrogen. Over 90 percent of the total nitrogen in soils resides in the soil organic matter. Microbial decomposition of the organic matter results in the release of nitrogen in the ammonium form (NH_4^+), a process called ammonification. Under conditions of good aeration and favorable temperatures different microorganisms oxidize the ammonium first to nitrite (NO_2^-) and then to nitrate (NO_3^-), a process called nitrification. The step from nitrite to nitrate is usually faster than from ammonium to nitrite so that practically no nitrite accumulates. If the content of ammonia (NH_3) in the system is high, however, nitrite may accumulate, and it is toxic to many organisms. If nitrate is exposed to conditions of poor aeration (reducing conditions), it will be reduced to gaseous nitrogen forms and lost to the atmosphere, a process called denitrification.

Ammonium ions are held on the cation exchange sites in soils, so the concentration of ammonium in the soil solution is not very high. The nitrate anion, on the other hand, is completely soluble in the soil solution, and it moves with the soil water. Therefore, nitrate is the form of nitrogen most subject to leaching. It is also subject to denitrification under reducing conditions.

Phosphorus. About half of the phosphorus in many surface soils exists in organic forms and half in inorganic forms. The inorganic forms are mainly iron and aluminum phosphates in acid soils and calcium phosphates in alkaline soils. All of the inorganic forms of phosphate in soils are extremely insoluble, and any phosphorus added as fertilizer or released by decomposition of the organic matter is quickly converted to one of these insoluble forms. Because of the extreme insolubility of these phosphates, the over-all concentration of soluble phosphorus in the soil solution of surface soils seldom exceeds 0.2 mg/l and concentrations in the range of 0.01 to 0.1 mg/l are common. Phosphorus concentrations in the soil solution of subsoil layers are usually less than 0.01 mg/l.

Soluble Nitrogen and Phosphorus in Surface Runoff and Percolates

The concentrations of nitrogen and phosphorus in surface runoff are considerably different from those in soil percolates. The ammonium and especially the nitrate forms of nitrogen are very soluble. If these materials are present at the surface of the soil at the beginning of a rain, the first rain that falls will dissolve them and carry them into the soil. If surface runoff occurs later, there will be little soluble nitrogen left at the surface to be carried away with the runoff. Therefore, runoff waters usually have very little soluble inorganic nitrogen. In fact, the nitrate contents of runoff waters are usually lower than the average nitrate content of rain water. This is due to the fact that the first rain that falls sweeps most of the nitrate from the air and carries it into the soil. The rain which falls later and runs off has a lower nitrate content.

Though runoff waters contain relatively little nitrate, this is not necessarily true of the water which percolates through the soil. As stated before, nitrate is completely soluble in the soil solution and moves with it. If the nitrate ions manage to evade capture by the plant roots as they move downward, they will be present in the drainage waters which move to the lakes and streams by base flow. Thus soil percolates generally have higher contents of nitrate than do surface runoff waters. This nitrate eventually reaches the waterways unless the water emerges in a marsh where it may be absorbed by the vegetation or converted to gaseous nitrogen because of reducing conditions.

The relative concentrations of soluble phosphorus in surface runoff and soil percolates are just the reverse of the nitrogen system. Application of phosphorus to the surface of the soil tends to saturate the "fixing" sites at the surface and locally raise the concentration of phosphorus in the soil solution. This is an equilibrium system, and although infiltrating waters will carry the soluble phosphorus downward, more will quickly dissolve to maintain the concentration in solution. Runoff water will contact this surface soil, and the phosphorus concentration in the runoff could conceivably approach the equilibrium concentration. If phosphorus fertilizers were applied to the soil surface, the equilibrium concentration of phosphorus in a thin surface layer could reach 1 mg/l or more and the concentration of phosphorus in the runoff water might range up to a few tenths of a mg/l. This is speculative, at best, since there are no data available which pertain directly to this problem. However, the fact that soluble phosphorus concentrations in surface runoff frequently approach or exceed the average concentrations expected in the soil solution would support this contention.

In the water which percolates through the soil, the soluble phosphorus concentration is usually very low because the phosphorus gets precipitated in the subsoil. Therefore, most of the soluble phosphorus should reach the waterways via surface runoff. This contrasts with nitrogen since most of the soluble inorganic nitrogen should reach the waterways mainly by percolation and base flow. These conclusions assume that the soils are not frozen. If the soils were frozen, a relatively large proportion of all soluble nutrients at the soil surface would be carried away in the runoff waters. This is undoubtedly the case during the initial stages of the spring thaw, and is of special significance for nutrients in manure or fertilizers applied on frozen fields.

Effects of Suspended Material. The energy associated with the impact of falling raindrops tends to break down aggregates of soil particles at exposed soil surfaces, and the runoff waters can then pick up the finer particles and carry them downslope, possibly to a stream. When runoff waters are concentrated in channels, the velocity of the water, and thus its erosive power, is increased and deep gullies may be formed. Much of the finer material eroded from a gully, mainly subsoil material, may end up in a stream. During periods of high flow, the streams themselves erode their banks and carry some of the eroded material downstream in suspension. Suspended materials, whatever their source, undoubtedly affect the nutrient status of the water, however, there are no data available to estimate the magnitude of their effect. Therefore, the following discussion is based mainly on theoretical arguments.

Nitrogen in suspended particles is present mainly in the organic form. Some of these particles will sediment out when the water velocity decreases, to be covered later by other sediments so that they do not contribute significantly to the soluble nitrogen supply. Other organic particles may be attacked by microorganisms with the nitrogen being converted to soluble inorganic forms in the decomposition process. Fresh organic materials are quite readily decomposed by microorganisms, but humified soil organic matter is quite resistant. Thus, the contribution of the suspended organic matter to the soluble nitrogen content will depend on the nature of the organic materials.

Phosphorus in suspended particles is present in both organic and inorganic forms. The organic forms would undergo the same reactions as nitrogen. However, the inorganic forms present a more complex system. The phosphorus bonded to iron, aluminum or calcium in the mineral particles tends to equilibrate with the phosphorus in solution. If the particles come from a surface soil high in phosphorus, they will tend to support a relatively high concentration of phosphorus in solution. If, on the other hand, the particles come from a subsoil low in phosphorus, they will support a low concentration of phosphorus in solution. In fact, if subsoil particles were introduced into a stream containing a moderate or high concentration of soluble phosphorus, they would adsorb phosphorus from the water thereby lowering the phosphorus concentration in solution. Since much of the sediment in streams during high flow is frequently derived from stream bank erosion, the phosphorus status of the sediments in the stream beds and stream banks may well be an important factor affecting the concentration of soluble phosphorus in the water during periods of high flow.

Since algae problems are found primarily in still waters where suspended materials have largely settled out, the contribution of eroded particulate matter to the nutrition of the algae is probably associated with its effects on the concentrations of soluble nitrogen and phosphorus in the incoming waters and not with the total or "extractable" amounts of nitrogen and phosphorus in the particles themselves.

Nitrogen and Phosphorus Sources in Agricultural Soils

Fertilizers are frequently thought to be the major sources of plant nutrients and, therefore, the major contributors to water fertilization in Wisconsin. This is not the case. According to State Department of Agriculture figures (Braatz, 1965), fertilizers sold in Wisconsin during the 1964-65 season contained approximately 50,000 tons of nitrogen and 40,000 tons of phosphorus. If a cropland acreage of 10,000,000 acres is assumed, this would amount to an average of about 10 pounds of nitrogen and 8 pounds of phosphorus applied per cropland acre. If potential nutrient contributions from legumes, animal manure, rainfall and decomposition of soil organic matter are taken into account, the relative contributions shown in Table 3 are obtained.

Table 3. Sources and estimated amounts of available nitrogen and phosphorus in cultivated soils in Wisconsin.

Source	Nitrogen Lbs./A.	Phosphorus Lbs./A.
Fertilizer	10	8
Legumes	12	-
Precipitation	8	-
O. M. Decomposition	45	5
Manure	42	12
Total	117	25

The estimates for the contribution of legumes are based on fixation of 40 pounds of excess nitrogen per acre per year on 3,000,000 acres. The precipitation data are taken from Shah (1962). Nitrogen and phosphorus release from soil organic matter is based on an average soil with 3 percent organic matter, the organic matter containing 5 percent nitrogen and 0.5 percent phosphorus and decomposing at a rate of 1½ percent per year (Woodruff, 1949). Manure estimates are based on 4,000,000 animal units at 15 tons of manure per animal unit per year and a manure composition of 0.5 percent nitrogen and 0.1 percent phosphorus. A 30 percent loss of nitrogen due to volatilization during handling and storage is assumed.

These average figures can be somewhat misleading as most of the manure and fertilizer nitrogen will be applied on about 2,700,000 acres of corn and vegetable crops, and some of the manure will be dropped on permanent pasture land. However, the average figure can be used to judge the probable relative importance of the various nutrient sources. The fertilizer contributes only about 9 percent of the nitrogen and 32 percent of the phosphorus which becomes available to the plant. Manure, on the other hand, contributes about 36 percent of the nitrogen and 48 percent of the phosphorus. It is obvious that the manure is a much greater factor in total nutrients applied than is commercial fertilizer. This is of special concern since much of this manure may be applied on frozen ground during the winter months so that it can contribute significant quantities of soluble nitrogen and phosphorus to the spring runoff waters.

Estimates of Soluble Nitrogen and Phosphorus in Surface Runoff from Rural Lands

There have been very few studies in which the contents of soluble nitrogen and posphorus were measured in surface runoff waters of Wisconsin. Therefore, there is always the danger of overinterpreting or misinterpreting the little information that is available. Estimates of soluble nitrogen and phosphorus in surface runoff have been made for the Lake Mendota watershed (Nutrient Sources Subcommittee, 1966) on the basis of runoff experiments conducted near Madison plus information obtained from Vermont and other states. These estimates are probably the best that are presently available, and they should be applicable to much of the agricultural region of south central Wisconsin. They would be less representative of other areas in the state, since the farming practices and the ratio of surface runoff to percolate will vary. However, they do serve to point out the major contributors of nutrients. For this reason, the sources of data and the basis for the estimates are given in considerable detail. It should be pointed out also that these estimates are only "best guesses" and may be in error by a factor of 2 or even more. Also, these data represent "average" conditions, and quantity and composition of both runoff and percolate can vary widely from year to year.

Characteristics of the Lake Mendota Watershed. The watershed of Lake Mendota is occupied by relatively permeable, calcareous, loamy glacial deposits with a significant covering of loess. Most soils have developed in this loess, but some soil development has occurred in the glacial till immediately below the loess. Many of the soils developed under prairie vegetation and have an A horizon which is 8 to 16 inches thick and relatively high in humus. Most of the watershed has gentle slopes. There are many small undrained depressions in the uplands and several large wetlands which contain organic soils.

The following table gives estimates of the acreage devoted to various land uses in the Lake Mendota watershed. These acreage figures were derived from data from the Wisconsin Crop and Livestock Reporting Service, Blueprint for Growth (1961) by the Dane County Citizen's Planning Committee, and from U. S. Geological Survey quadrangle maps.

Table 4. Land Use in the Lake Mendota Watershed.

Land Use	Acres		% of Watershed	
Cropland*	103,500		73	
Corn and Row Crops*		(51,000)		(36)
Oats*		(18,500)		(13)
Hay and Pasture*		(34,000)		(24)
Woodland**	10,000		7	
Pasture and Other*	11,400		8	
Major Wetland**	7,100		5	
Urban**	10,000		7	
Total	142,000		100	

*Estimated from cropland uses in Dane County reported by Wisconsin Crop and Livestock Reporting Service and Blueprint for Growth by Dane County Citizens Planning Committee.

**Estimated from U.S.G.S. quadrangle maps.

The following table summarizes the estimates made of the nitrogen and phosphorus contents of the surface runoff from cropland, woodland, manured land and wetland in the Lake Mendota watershed. The methods and source materials used in obtaining the estimates are described in the sections following the table.

Table 5. Estimates of Soluble Nitrogen and Phosphorus Contained in Runoff Waters in the Lake Mendota Watershed.

	Nitrogen Lost		Phosphorus Lost	
Land Use	Lbs./A.	Lbs./Watershed	Lbs./A.	Lbs./Watershed
Cropland and Pasture1/	0.06	6,900	0.04	5,400
Woodland2/	0.03	300	0.003	30
Wetland3/	-	-	-	-
Manured Land4/	3	45,000	1	15,000
Total		52,200		20,430

1/ Derived from data of Eck, Jackson and Bay, Annual Report, A.E.S. project 791 (Phase 5), 1957.

2/ Concentrations taken from Sylvester, R. O. (1960) as quoted in "Limnological Aspects of Recreational Lakes," Public Health Service Publication 1167.

3/ No data on which to base an estimate.

4/ Figures for Lbs./A. from Midgley and Dunklee, Bul. 523, Agricultural Experiment Station, University of Vermont, 1945.

Runoff From Cropland and Pasture

The estimates of the nitrogen and phosphorus contents in the surface runoff from cropland and pasture are based on the data of Eck, Jackson and Bay (1957) which were obtained from a Miami silt loam with a 10 percent slope. Although Eck et al. (1957) report values for total nitrogen and pH 3 extractable phosphorus as well as water soluble phosphorus and nitrate nitrogen, only the water soluble forms are considered in these calculations. The total nitrogen and pH 3 extractable phosphorus should be associated almost exclusively with suspended particulate material, most of which would undoubtedly sediment out before reaching the lake. The values for nitrate losses per acre are considerably lower than those of Eck et al. Their values for concentration in the runoff were used and 2 inches of runoff per year was assumed. The values which they report would have required a runoff of almost 9 inches per year. The values given are for an intensive three-year corn-oats-hay rotation and the "permanent pasture and other" category was included with the cropland.

Runoff From Woodland

No data could be found on the nutrient content of surface runoff from local wooded areas, so this was estimated from the nitrogen and phosphorus contents in streams flowing from wooded areas (Sylvester, 1960). These are very rough estimates, at best, because it is impossible to estimate the relative contributions of surface runoff and base flow.

Runoff From Manured Land

The use of manure on frozen land can result in relatively large losses of nutrients in runoff waters. Since spring meltwaters cannot enter the frozen soil, they run off carrying with them the soluble constituents of the manure. The common practice of spreading manure daily means that it is spread on frozen soil about five months during the year. The calculation of nitrogen and phosphorus losses from manured land required estimates of the manure applied and the amount of loss from a given application. The Wisconsin Crop and Livestock Reporting Service report that there are approximately 76 dairy cows per square mile in Dane County. Since the Lake Mendota watershed has a higher than average percentage of cropland than the rest of Dane County, a density of 100 cows per square mile was assumed. This amounts to approximately 20,000 cows in the watershed. If each cow produces 15 tons of manure per year and one-half of that manure is applied during the months of November through March, about 150,000 tons will be applied on frozen ground. This is undoubtedly a high estimate if only manure production by dairy cows is considered, but this will be augmented by manure produced by steers, hogs, chickens and young stock. If this amount of manure were applied at a normal 10-ton per acre rate, it would cover 15,000 acres. The data of Midgley and Dunklee (1945) indicate that about 3 pounds of nitrogen and 1 pound of phosphorus were lost from a 10-ton per acre application of manure on an 8 percent slope in Vermont when the ground was frozen. It should be emphasized that these figures may be high. Although Midgley and Dunklee did not state the forms of nitrogen and phosphorus determined, one gets

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the impression from reading the paper that it was total nitrogen and phosphorus. If this were the case, some of the particulate material would undoubtedly settle out before reaching a stream, resulting in lower amounts actually reaching the lake. Also, they applied all of the manure on snow covered land in December and January which would afford maximum chance for losses to occur.

Runoff From Marshlands

One would suspect that runoff from marshland might, under the right circumstances, make a very significant contribution to the nutrient content of lakes and streams. However, little data could be found that would suggest even the order of magnitude of this contribution. Theoretically, the potential release of nutrients, especially nitrogen, would be large but extremely variable depending on conditions of weather and drainage. Drained marshes offer ideal conditions for production of nitrates through aerobic decomposition of the organic matter. The amount of this nitrate reaching the lake would depend on the total amount produced, absorption by plants, and amount and distribution of rainfall.

Undrained marshes, on the other hand, present a very complex picture. If the summer and fall periods were relatively dry so that the water table receded, the rate of nitrate production would probably exceed the rate of absorption by plants. Thus nitrates might accumulate and be flushed out with the spring runoff. However, if the fall season were wet so that saturated conditions prevailed in the marsh, and if the temperature were high enough during this time to support a moderate rate of microbiological activity, any nitrates present would probably be denitrified under the resulting reducing conditions and the spring runoff would contain little nitrate. This does not necessarily mean that the total mineral nitrogen content would be low because ammonification reactions can proceed under anaerobic conditions so that the NH_4^+ content might be significant.

The data of Mackenthun (1962), which include data from Sawyer, Lackey and Lenz (1945), indicate that marshland may have contributed to the much higher inorganic nitrogen content in Door Creek than in other streams with less marshland, but it is impossible to estimate the relative contribution of the undrained marshland with any degree of accuracy. Sawyer et al. (1944) found that the Picnic Point pump furnished 8.7 percent of the inorganic nitrogen entering Lake Mendota from stream flow, although it contributed only 1.7 percent of the flow. The water from this source was drainage water from the University marsh which gives an idea of the potential nitrogen contribution from drained marshes.

The analytical information available did not seem adequate for making even rough estimates of the nutrient contribution of marshlands and so no estimates are included. Most of the analytical data encountered were for grab samples which were not taken throughout the period of peak spring runoff from marshy areas, and which included undeterminable contributions from agricultural lands, base flow and possibly sewage effluent.

Ground Water

Precipitation that enters the soil and is not evaporated or transpired becomes part of the ground water. This later may re-appear at springs to feed lakes and streams maintaining base levels and flows or be pumped out of wells. The average nutrient concentrations of 0.01 mg/l of phosphorus and 1.2 mg/l of nitrogen from orthophosphates and nitrates found in Wisconsin water supplies should be comparable to the average levels found in ground waters. The movement of water through the soil is slow. It will probably be years before the impact of present nitrogen applications in fertilizers and wastes show up as nitrates in our surface waters.

Ground water flows are highly variable depending on areal physical characteristics as well as precipitation. Stahl (1965) cited a 70 percent ground water contribution to total flow for the La Crosse River above West Salem compared to 15 percent in the total runoff of the Black River near Neillsville. Based on an annual 30 inches of precipitation, the estimated combined ground water outflow plus well pumpage for the state as a whole is approximately 3-4 inches (Wis. Geol. Sur., 1966). Use of these figures for any year or specific area could result in a large discrepancy.

There is little information on the effect of current agricultural and land disposal practices on the nitrate content of the ground water. Therefore, there is a need for studies involving:

1. Factors affecting the movement of nitrate to the ground water.
2. Rate of movement and flow patterns of nitrates in ground water.
3. The importance of denitrification reactions.
4. Concentrations of nitrates in emerging ground water.

A logical starting point for such a study would be the sandy section of central Wisconsin which is currently undergoing rapid development for the growing of vegetable crops. The combination of sandy soils, high nitrogen additions and supplemental irrigation make this a potential problem area as far as nitrates in ground waters are concerned. A cooperative study involving the four points listed above would seem very desirable.

Conclusions on Rural Nutrient Contributions

Wisconsin receives an average of about 30 inches of precipitation per year. Of this, approximately 24 inches are lost by evapotranspiration and about 6 inches reaches surface waterways by a combination of surface runoff and base flow of water which has percolated through the soil. The ratio of surface runoff to base flow varies with soil type, slope, management and surface cover, but an average figure of about 1 to 2 inches for surface runoff and 4 to 5 inches for base flow would probably be close.

The plant nutrients, nitrogen and phosphorus, which are of concern in surface waters because of their role in the growth of algae, are found in both surface runoff and percolate. However, the distribution of both these nutrients between surface runoff and percolate depends on the chemical reactions which these elements undergo in soils. The inorganic forms of nitrogen, especially the nitrate form, are very soluble and move into and through the soil with the water. Therefore, more inorganic nitrogen appears in the percolate than in the surface runoff. Phosphates, on the other hand, form very insoluble precipitates with iron, aluminum and calcium compounds in the soil so that very little appears in the percolate. Since surface applied phosphates tend to remain near the surface and maintain a high equilibrium phosphate concentration in the surface soil solution, the surface runoff contains considerably higher concentrations of phosphorus than does the percolate. If soluble forms of either nitrogen or phosphorus are applied on frozen soil, the surface runoff waters will contain relatively high amounts of both nutrients until the soil thaws.

The major potential source of nitrogen and phosphorus in surface runoff from rural lands would appear to be manure applied on frozen soil. Any commercial fertilizer containing nitrogen and/or phosphorus applied on frozen soil would also be a factor, but relatively little is applied in this manner. Commercial fertilizer or manure applied when the soil is not frozen would not seem to be a heavy contributor to nutrients in streams and lakes. The greatest contribution in this category would probably be from phosphate fertilizers top-dressed on hay lands. Contributions of nitrogen and phosphorus from wetlands are difficult to estimate, but there is no question but what drainage waters from drained marshes will be relatively high in soluble nitrogen. Sources and amounts of nitrogen in soil percolates and the fate of this nitrogen need further investigation, but the Lake Mendota study suggests that this is an extremely important source.

Urban Runoff

As part of the Madison lakes survey, Sawyer & Associates (1943) studied storm water drainage to Lake Monona. They estimated that the storm water volume average did not exceed 10 cubic feet per second. Representative samples showed mean nitrogen values of the following: Ammonia, 0.28; organic, 1.30; nitrite, 0.02; and nitrate, 0.14 ppm. Mean total and soluble phosphorus amounted to 0.78 and 0.22 mg/l. The latter is about 10 times that of a normal stream water, while the nitrogen content is similar. High concentrations of soluble phosphorus in November 1942 were believed due to the burning of leaves in the streets.

Sylvester (1961) reported on a 1959 Seattle study. A mean total Kjeldahl nitrogen (ammonia and organic nitrogen) concentration in urban street drainage of 2.54 mg/l with 0.53 mg/l of nitrate nitrogen was found. The mean total and soluble phosphorus concentrations were 0.208 and 0.076 mg/l. Runoff from a major highway had the highest nitrogen values. Arterial streets contained the most soluble phosphorus and residential streets the highest total phosphorus concentration. The samples were obtained from the street gutters and generally excluded roof drainage. As expected, highest nutrient concentrations were found in the earlier periods of runoff.

A Cincinnati study of 1962-63 covering a 27-acre residential-light commercial area with separate storm sewers was reported by Weibel et al. (1964).

The mean nutrient concentrations found in mg/l follow: Nitrite-N, 0.05; nitrate-N, 0.4; ammonia-N, 0.6; organic-N, 1.7; and soluble phosphorus, 0.26. The total nitrogen is equivalent to 8.9 pounds/acre/year and the soluble phosphorus 0.82 pounds/acre/year. Here too, there was a decrease in nutrient concentration with time after start of runoff.

The mean soluble phosphorus in the Madison and Cincinnati studies are similar - 0.22 compared to 0.26 mg/l, but the Seattle value is only about one-third as much. Weather Bureau data shows the average precipitation for a 30-year period, 1931-60, for the cities as follows: Seattle, 38.94 inches; Madison, 30.16 inches; and Cincinnati, 38.02 inches. The Cincinnati nutrient data is the most recent and for a residential-light commercial section, while the Seattle study generally did not include roof drainage. It is believed that the Cincinnati values of 8.9 and 0.82 pounds/acre/year of total nitrogen and soluble phosphorus would be similar to current runoff from urban areas in Wisconsin. The total phosphorus, which was missing from the Cincinnati data, would be about 2.5 pounds/acre/year by applying the phosphorus ratios found for the other two cities.

Of the state's 36,147,760 acres the urban acreage amounts to 377,200 acres or about 1 percent of the total. Urban land is that within the corporate limits of all sections with populations of 5,000 and over. If we include incorporated communities of less than 5,000, the urban acreage would be increased by 292,100 acres to 669,300 acres (Wis. Dept. Res. Dev., 1963). Wisconsin's average rainfall amounts to 30 inches annually. Of this, 20 inches is evaporated and transpired and the remaining 10 inches eventually flows out of the state (Wirth, 1959). Urban areas, because of their roofs and pavements, have larger amounts of direct runoff and less evapotranspiration to the atmosphere and seepage into the soil. As rough estimates for urban areas in Wisconsin, the evaporation and transpiration would be in the vicinity of 15 inches, the water seeping into the ground would account for probably 3 inches and direct runoff about 12 inches.

Included in the Cincinnati study (Weibel, 1964) is a figure for the dustfall at an air pollution station in the test area. This amounted to 506 pounds/acre/year as compared to 730 pounds/acre/year of suspended solids in storm runoff during the same time. There was no breakdown concerning make-up of the dustfall.

Subsources of nutrients in urban areas are not well defined. It might be expected that smoke and industrial emissions account for a large share of the nutrients. The automobile, pets and urban lawn fertilization practices are suspects, too.

The pall that overhangs our urban areas is fairly well documented, but its nutrient make-up leaves much to be desired. The suspended particulate matter in urban U. S. atmospheres, based on 22,500 air samples at 232 stations, averaged 115 micrograms per cubic meter of air for the 1957-63 period (U. S. Bur. Census, 1965). The concentration increased progressively with population size from 80 in the 10,000 to 25,000 population centers to 182 micrograms per cubic meter in sections of 3-million and more inhabitants. The arithmetic average in 8 non-urban areas in the U. S. amounted to 36 micrograms per cubic meter. Included in the gaseous air pollution level data were averages for six large U. S. cities. Nitric oxide averages ranged from 0.03 ppm in Washington, D. C. to 0.10 ppm in Chicago, while nitrogen dioxide varied from 0.03 ppm in Cincinnati and St. Louis to 0.06 ppm in San Francisco.

Most of the airborne nutrients are of terrestrial origin and grounding them by precipitation and fallout only represents a redistribution over the land. Runoff from land areas may include some of this nutrient matter.

Precipitation

Precipitation helps flush out dust and certain gases from the atmosphere. A limited amount of data is available on the amount of nitrogen in precipitation but there is virtually no information available on its phosphorus content.

During June 1963, in conjunction with a fallout measurement for radioactivity, rainfall was analyzed for nitrate-N on three occasions and showed concentrations of 0.42 to 0.55 mg/l. A single analysis revealed 2.3 mg/l of ammonia-N, 0.026 mg/l of nitrite-N and 0.03 mg/l of soluble phosphorus. The samples were collected atop the Laboratory of Hygiene building in Madison.

Carroll (1962) cites 1958 data, after Junge and Werby, for 18 stations in conterminous U. S. The nitrate-N varied from 0.16 to 1.05 and averaged 0.52 mg/l, while the ammonia-N values ranged from 0.04 to 1.7 and averaged 0.34 mg/l. Average precipitation in the U. S., and also in Wisconsin, is approximately 30 inches annually. Using the latter figure and the 0.86 mg/l of inorganic nitrogen, one arrives at a precipitation contribution of 5.8 pounds/acre/year.

Thunderstorm activity has been credited with contributing about one-half pound of nitrogen from nitrites and nitrates and precipitation with flushing out an additional two to six pounds of nitrogen per acre annually (Allison, 1957). Larson and Hettick (1956) noted that the sulfate concentration was usually about double the combined nitrate plus ammonia and felt that the nitrogen contribution by lightning was insignificant compared to that of fossil fuels. Shah (1962) shows nitrogen in precipitation at six Wisconsin stations for the years 1958 and 1959 - four of the stations were the same both years. The average precipitation at the 1958 stations amounted to 21.1 inches and the nitrogen contribution amounted to 4.1 pounds per acre. Only nitrates were determined in the fall quarter of 1958 and, therefore, these values would be low. In sharp contrast, the 1959 rainfall averaged 38.1 inches at the stations and the average nitrogen amounted to 13.6 pounds per acre.

Nutrients from the atmosphere may fall directly into surface waters. Wisconsin's water area within the state amounts to 1,136,920 acres or 3.1 percent of the total (Wis. Dept. Res. Dev., 1963). Analysis of precipitation includes part of the direct nutrient contribution to surface waters, but fallout of particulate matter not downed by precipitation would represent an additional contribution.

Waterfowl

Studies of duck farm waste were reported by Sanderson (1953) in 1953. His data showed that the average daily contribution for 1,000 ducks amounted to 5.7 and 7.6 pounds of total nitrogen and phosphate respectively, while the soluble phosphate amounted to 3.6 pounds. These values are equivalent to 2.08 pounds of nitrogen, 0.90 pound of total phosphorus and 0.43 pound of soluble phosphorus per duck per year. The total nitrogen was said to vary little, but the total phosphate ranged from 4.7 to 10.5 pounds each day per 1,000 ducks. However, the ratio of soluble to insoluble phosphate was relatively constant. Phosphate fluctuations probably were due to the make-up of the food. Pilot plant treatment of the wastes by an Imhoff tank had an undesirable effect in that it increased the soluble phosphorus over that found in the raw.

Mackenthun et al. (1964) reported that Paloumpis and Starrett used a factor of 0.5 applied to the previous figures to allow for diet differences of wild ducks. For the latter on an Illinois lake, they arrived at an annual contribution of 12.8 pounds of nitrogen and 5.6 pounds of phosphorus per acre.

Wild ducks tend to feed in the water and may not contribute additional nutrients. However, their excreta contains considerably more inorganic nitrogen and phosphorus than their food, making nutrients more readily available for new aquatic growth than if the usual decay and subsequent nutrient release took place. Geese are apt to feed on land and bring additional nutrients into the water. Migratory waterfowl may be in the state only a relatively short time. It is anticipated that where high waterfowl populations, supplemental feeding, year-around open waters, domestic duck farms, etc., are involved, localized problems could occur but state-wise the nutrient contribution from waterfowl is probably not significant.

Chemical Deicers

A non-corrosive mixture for the chemical removal of ice and snow at airports has been patented. Its composition according to the patent indicates 22 to 29 percent urea, 71 to 78 percent ammonium nitrate and up to 2 percent of various sodium phosphates. Another formulation for runway deicing consists of 75 percent tripotassium phosphate and 25 percent formamide. The potential market for runway deicers is estimated in tens of millions of pounds per year (Anon., 1965).

During the winter of 1964-65 a total 160,000 tons of chlorides were applied to Wisconsin state trunk highways for deicing (Schraufnagel, 1965). The sodium and calcium in the runoff probably does not have an adverse effect on water quality. However, sodium hexametaphosphate, which is marketed as an additive to prevent corrosion, could provide a source of phosphorus and add to aquatic fertility. The chloride runoff study indicated little usage of the phosphate additive in Wisconsin. An inquiry was made at Truax Field concerning their practices. Chlorides, because of their corrosiveness, are used sparingly and no use is made of the other mentioned airport deicers. The chlorides as applied are usually mixed with sand.

During the past few winters, an increasing number of stores have been noted handling chemical deicers. These are generally packaged in small plastic bags and are being promoted for use on sidewalks and driveways. Typically, the deicer formulation is not indicated. The majority probably are calcium chloride and one is sodium chloride, but some of them are ammonium sulfate, others are ammonium nitrate and one contains potassium pyrophosphate plus formamide. Warnings concerning damage to concrete surfaces by the forementioned ammonium compounds have been issued by the Portland Cement Association and others (McCord, 1966) (Lerch, 1962) (Anon., Milw. Jour., 1966). The extent of their use was not determined; however, with the increasing number of retail outlets marketing deicers, this source of inorganic nutrients could become significant in a short time. Ammonium nitrate and ammonium sulfate contain 35 percent and 21 percent, respectively, of inorganic nitrogen.

Nitrogen Fixation in Surface Waters

Although the earth's atmosphere is predominately nitrogen, the gas is generally not an available nutrient. However, some strains of blue-green algae and certain groups of photosynthetic bacteria have the ability to utilize atmospheric nitrogen and incorporate it into living cell material.

In "Report on Nutrient Sources of Lake Mendota" (Nutrient Sources Comm., 1966), test results by Goering (1963) were used in arriving at the nitrogen contributed by nitrogen fixation. A conservative estimate of 80,000 pounds of nitrogen per year were attributed to nitrogen fixation. This is equivalent to a little over eight pounds/acre/year. The value obtained is admittedly a rough estimate based on Lake Mendota data. Its applicability to other lakes is questionable.

Sawyer and Ferulla (1961) indicated that nitrogen fixation was greatest in lakes receiving fertilization from sewage or farm drainage and implicated phosphorus as the key element in nitrogen fixation. This suggests a snowballing effect if phosphorus is available.

Bottom Sediments

Only brief mention will be made of bottom sediments, since they usually do not involve new fertility sources but rather make nutrients available for use and reuse.

Bottom sediments, including runoff particulate matter, waste sludges, decaying aquatic residues, etc., contain nutrients which are generally not readily available but are tied up organically or chemically. Their availability is complex and affected by such things as depth, area, benthic organisms, temperature, water chemistry and turnover.

Potentially, bottom sediments can represent a long-term nutrient reservoir. This and nutrient cycling can help explain why once a body of water becomes fertile it can remain adversely affected for a long period even though the primary nutrient sources have been eliminated.

Nutrient Estimates

In order to better appraise the significance of the various sources, the following crude state-wide estimates of nutrient contributions are shown:

1. Municipal Sewage Treatment Plant Discharges

a. Domestic Sewage. In 1960 these facilities served 67.5 percent of the state's population. It is estimated they now serve 68.5 percent of the state's population or 2,860,000 persons. Per capita, it is assumed that the annual contributions amount to 10 pounds of nitrogen and 3.5 pounds of phosphorus and that an over-all reduction of 40 percent is achieved by treatment.

Nitrogen = 17,200,000 lbs.
Phosphorus = 6,000,000 lbs.

b. Milk Wastes Tributary to Municipal Facilities. Consider that about 7 of the 17-billion pounds of milk are processed by factories that utilize municipal treatment facilities. Assume an over-all milk loss of 2 percent containing 0.096 percent phosphorus and 0.6 percent nitrogen. Add 50 percent to phosphorus for cleaning compounds.

Nitrogen = 500,000 lbs.
Phosphorus = 126,000 lbs.

c. Meat Packing. Consider that the secondary treatment plant effluent from one large meat packer for which data is available as being indicative of one-fourth of the meat packing nutrients discharged after treatment.

Nitrogen = 1,340,000 lbs.
Phosphorus = 350,000 lbs.

d. Canning, Laundry, Tanning and Other Wastes. (Not separately tabulated.) Estimated total discharge from municipal treatment plants, items a through d.

Nitrogen = 20,000,000 lbs.
Phosphorus = 7,000,000 lbs.

2. Private Sewage Systems

Approximately 1,317,000 of Wisconsin's resident population use private sewage disposal systems. Summer homes and accommodations for out-of-state tourists could boost the over-all equivalent use of private systems to about 1,600,000 people. Discharge of septic tank treated sewage into surface waters is prohibited, but violations do occur. Soil can remove virtually all of the phosphorus but nitrogen removals are variable. Use the same over-all nutrient figures as for those connected to public sewerage facilities and estimate that 5 percent of the phosphorus and 30 percent of the nitrogen eventually gets into the surface waters.

Nitrogen = 4,800,000 lbs.
Phosphorus = 280,000 lbs.

3. Industrial Wastes

Aside from the pulp and paper mills which discharge relatively low nutrient wastes, most of the other factories handling organic materials and not connected to municipal facilities use land disposal systems. Their over-all contribution is estimated as approximately 1,500,000 pounds of nitrogen and 100,000 pounds of phosphorus.

4. Rural

a. Manured Lands. Estimate 2,700,000 acres and a runoff loss of 3 pounds of soluble nitrogen and 1 pound of soluble phosphorus per acre.

Nitrogen = 8,110,000 lbs.
Phosphorus = 2,700,000 lbs.

b. Other Cropland. Estimate 9,600,000 acres with nutrient losses of 0.06 and 0.04 pound per acre of nitrogen and phosphorus.

Nitrogen = 576,000 lbs.
Phosphorus = 384,000 lbs.

c. Forest Land. Estimate 14,500,000 acres and runoff losses of 0.03 and 0.003 pound per acre of nitrogen and phosphorus.

Nitrogen = 435,000 lbs.
Phosphorus = 43,500 lbs.

d. Pasture, Woodlot and Other. Estimate 9,000,000 acres and nutrient loss of 0.06 pound per acre of nitrogen and 0.04 pound per acre of phosphorus.

Nitrogen = 540,000 lbs.
Phosphorus = 360,000 lbs.

e. Wetlands runoff and drainage from wetlands is believed to be extremely variable. No estimate attempted.

f. Ground Water. Assume 0.01 mg/l of soluble phosphorus and 1.2 mg/l of soluble nitrogen in the ground water and 3.5 inches annually per acre from approximately 36,000,000 acres.

5. Urban Runoff

Assume 500,000 acres with a runoff of 8.9 and 2.5 pounds per acre per year of nitrogen and phosphorus, respectively.

Nitrogen = 4,450,000 lbs.
Phosphorus = 1,250,000 lbs.

6. Precipitation on Water Surfaces

Assume that the 30 inches of annual precipitation falls on 1,136,920 acres of water surface and that the precipitation contains 0.9 mg/l of inorganic nitrogen and 0.02 mg/l of soluble phosphorus.

Inorganic Nitrogen = 6,950,000 lbs.
Soluble Phosphorus = 155,000 lbs.

7. Waterfowl

Probably no significant additional nutrient contributions are involved. See previous discussion.

8. Nitrogen Fixation

Variable, but may be significant in some waters. No estimate attempted

9. Chemical Deicers

Nitrogen and phosphate compounds are being promoted for deicing but their uses in the state to date are believed negligible.

Table 6

Summary of
Estimated Nitrogen and Phosphorus Reaching
Wisconsin Surface Waters

Source	N	P	N	P
	Lbs. Per Year		(% of Total)	
Municipal Treatment Facilities	20,000,000	7,000,000	24.5	55.7
Private Sewage Systems	4,800,000	280,000	5.9	2.2
Industrial Wastes*	1,500,000	100,000	1.8	0.8
Rural Sources				
Manured Lands	8,110,000	2,700,000	9.9	21.5
Other Cropland	576,000	384,000	0.7	3.1
Forest Land	435,000	43,500	0.5	0.3
Pasture, Woodlot & Other Lands	540,000	360,000	0.7	2.9
Ground Water	34,300,000	285,000	42.0	2.3
Urban Runoff	4,450,000	1,250,000	5.5	10.0
Precipitation on Water Areas	6,950,000	155,000	8.5	1.2
Total	81,661,000	12,557,500	100.0	100.0

*Excludes industrial wastes that discharge to municipal systems.

Table does not include contributions from aquatic nitrogen fixation, waterfowl, chemical deicers and wetland drainage.

The tabulation shows that ground water contributes the most nitrogen to surface waters and it is essentially as nitrates. Municipal treatment plants are by far the largest source of phosphorus and they are the second largest nitrogen contributor.

Over-all, the nitrogen to phosphorus ratio of nutrients reaching surface waters is about 6½ to 1. Mackenthun et al. (1964) cited laboratory investigations by Gerloff and Skoog showing that 5 units of nitrogen plus 0.08 units of phosphorus would produce 100 units of algae. Their experimental work indicated a ratio of about 60 to 1, but in natural occurring algae and submerged plants the ratio is about 10 parts of nitrogen to 1 part of phosphorus. Sawyer, Lackey and Lenz (1945), following a study of southeastern Wisconsin lakes, set forth inorganic nitrogen and phosphorus concentrations of 0.3 and 0.015 mg/l respectively as the minimum average annual concentrations that would result in frequent nuisance blooms. The latter ratio is 20 to 1. Were it not for the alleged role of phosphorus in the stimulation of nitrogen fixation (Sawyer and Ferulla, 1961), the ratios would implicate nitrogen as generally being the limiting nutrient in Wisconsin surface waters.

IV. CONTROL METHODS

Nutrient Removal by Further Treatment

Conventional waste water treatment plants are designed to remove floatable and settleable solids and biochemical oxygen demand (BOD). A well-run secondary sewage treatment plant can produce a sparkling clear, well oxidized, stable effluent which is relatively low in BOD, inoffensive in odor, and with reduced numbers of pathogenic organisms. Therefore, it may be concluded that properly designed and operated sewage treatment plants do an admirable job in producing an effluent that is relatively inoffensive. However, in recent years, considerable concern has been focused on the role of treated sewage effluent in the fertilization of natural waters. Numerous studies have shown that properly treated sewage effluent contains significant amounts of nitrogen and phosphorus compounds and, therefore, can represent a potentially important source of plant nutrients for the receiving waters. Conventional sewage treatment does remove some plant nutrients. For example, Levin (1963) concludes that approximately a 20 to 40 percent reduction in phosphorus can usually be expected. Johnson *et al*. (1956) (1958) agrees with this conclusion and states that a range of 30 to 50 percent nitrogen removal is reasonable for most plants.

During the past 25 years there have been numerous laboratory studies on methods to improve nitrogen and phosphorus removal in sewage treatment. These studies have ranged from modification of existing treatment procedures to providing a third stage or tertiary treatment processes designed specifically for nutrient removal. These processes may be divided into two groups - chemical methods and biochemical methods. Examples of processes available in each group are discussed below. Additional references on the reduction of nutrients in sewage effluents and other methods of control can be found in review (Mackenthun and Ingram, 1964) (*Algae Metro-Wastes*, 1960) (Ingraham, 1964) (Oglesby and Edmondson, 1966).

Chemical Methods*

Precipitation with chemicals has been used as a secondary treatment process for many years. In Europe the natural corrosion of scrap iron in "fill-and-draw" batch tanks has been used since about 1930 to produce a chemical floc at a very low cost. Feng (1950) and Scott (1947) conducted laboratory studies using this material on Madison, Wisconsin, sewage effluent, with removal of nutrient materials as a primary objective. Removals were not as high as might have been desired, with 50 to 80 percent removal of nutrients resulting from 5 to 5½ hours of contact time. They both concluded that the extremely long detention times required for iron flocculation by corrosion nullified the low chemical cost advantage of the procedure. Neither investigator studied the effects of long periods of use upon the scrap material, but it may be the case that longer and longer detention times would be required as corrosion products accumulate upon the surface of the iron. Since long detention times and batch operations (twice as many holding tanks required for switching) would greatly increase the construction costs of such a plant, the objection to the use of the method in practice is an economic one. More corrosion could be produced in a shorter time by pH adjustment, but this is also prohibitively expensive for all but the smallest flows.

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*This section of the report is principally derived from a University of Wisconsin Water Chemistry Seminar paper by Fred Doll (Lee & Fruh, 1965).

For phosphorus removal, the use of precipitating chemicals in a final settling tank has been investigated. Lea et al. (1954) have investigated the use of alum (aluminum sulfate - $Al_2(SO_4)_3 \cdot 14H_2O$) as a coagulating agent for effluent from the Nine Springs Treatment Plant in Madison, Wisconsin. Their work indicated that 99 percent removal of soluble phosphorus could be effected with an alum dosage of 300 ppm, and that the most economical dosage would be about 185 ppm with 96 percent reduction of soluble phosphorus. The optimum pH of removal was 7.1 to 7.7. Studies by Henricksen (1963) indicated that the optimum pH may be somewhat lower, and stated that the fundamental mechanism of removal may be sorption rather than precipitation. Studies of alum precipitation by Malhotra et al. (1964), Rohlich (1963), Katz (1949) and Scott (1947) have substantiated the conclusions of Lea et al. (1954). About 6 to 10 times more alum by weight is required for this treatment than for conventional water treatment processes, and the disposal of very great amounts of sludge is a problem. Lea's et al. work included a scheme for the recovery and reuse of alum by the addition of sodium hydroxide and calcium chloride to the sludge to form soluble sodium aluminate and precipitate tri-calcium phosphate. The sodium aluminate solution is adjusted in strength and pumped back to the settling tank for further coagulation. The tri-calcium phosphate is separated by sedimentation and is a by-product, possibly marketable, of the process. The equations are shown below.

$$Al(OH)_3 \cdot (PO_4)^{\equiv} + 4NaOH = NaAlO_2 + Na_3PO_4 + 2H_2O + 3OH^-$$

$$NaAlO_2 + 2NaPO_4 + 3CaCl_2 = NaAlO_2 + Ca_3(PO_4)_2 + 6NaCl$$

Pilot plant studies have shown that the process is then economically feasible, with reported reductions in soluble phosphorus of 79 to 89 percent and about 80 percent recovery of the alum. However, the process is somewhat complex to operate, and lack of adequately trained personnel for plant control of such a scheme remains as an obstacle to its use in practice.

Other common coagulants which have been used in water and waste water treatment are the iron salts, ferric sulfate and ferric chloride. Katz (1949) reports 100 ppm of ferric sulfate for 80 percent removal of phosphorus. The difference in performance is probably due to the fact that iron salts produce a "heavier" floc than alum, and generally perform better at equal weights of chemical added. Even the use of 60 ppm of ferric sulfate results in the addition of about 3 tons of chemical per day to a flow of 15 MGD, and the problems of sludge disposal and economic feasibility without iron recovery are significant.

Lime is a commonly used precipitant in sewage treatment because of its low cost. Malhotra et al. (1964) used both lime and sodium hydroxide to precipitate hydroxy-apatite and/or tri-calcium phosphate in a comparative study. It was concluded that lime was most satisfactory, with 90 percent soluble phosphorus removal at a dosage of 600 ppm and a pH of 11.0. The extremely large volumes of sludge obtained and the high pH of the effluent, are the major disadvantages. It may be possible to calcine the sludge and reuse the lime, thus saving on chemical costs, but an additional equipment investment is required, and operation of this equipment requires trained personnel. As will be seen later, the high pH of the effluent may be of some advantage for the subsequent stripping of ammonia nitrogen. Malhotra et al. (1964) also investigated the use of coagulant aids (bentonite and Separan NP-10) for alum flocculation, but concluded that phosphorus reduction was not markedly enhanced by the use of these aids. Owen (1953) reached similar conclusions with regard to lime precipitation of phosphorus.

Katz (1949) used an ion exchange resin (Amberlite IR-4B) for phosphorus removal and achieved 92 percent reduction. This treatment method is not presently of practical importance because of the high initial cost of the resin, regeneration and operation costs, and the need for preliminary filtration to remove suspended matter. Recently, Eliassen et al. (1965) have reported the results of studies on the use of ion exchange for nutrient removal from secondary effluent. Their results are essentially the same as those reported by Katz.

Føyn (1962) has studied the possibility of removing sewage effluent nutrients by electrolytic means. He developed a process which he called the Electrolytic Sewage Purification Method, which utilizes sea water for the production of magnesium, and its subsequent use as a precipitant chemical. This process has been tried on a pilot plant scale and has worked satisfactorily. Economic feasibility is dependent on the availability of large amounts of low cost electrical power and brines. The high chloride content of the effluent may be objectionable.

The successful removal of nitrogen from effluents presents more difficulty than the removal of phosphorus, because nitrogen is not susceptible to the usual precipitation methods. It is undoubtedly true at the present time that biological removal methods, particularly modifications of the activated sludge process and the use of oxidation ponds for oxygen stabilization and nutrient reduction of the final effluent hold the most promise.

The element nitrogen exists in sewage in several forms: Nitrogen gas, nitrate and nitrite ions, ammonia and organic matter. In view of the fact that as much as 60 percent of the total nitrogen in sewage may be represented by ammonia, the elimination of this gas by stripping at a pH greater than about 9.5 seems to be one alternative approach to the problem. Kuhn (1956) and Nesselson (1964) have used countercurrent air stripping in a 2-meter high percolation tower packed with Raschig rings and achieved 92 percent removal of NH_3 when roughly 400 m^3 of air was used per m^3 of sewage at pH 11. It is conceivable that the high pH resulting from previous lime precipitation of phosphorus could be used advantageously in this process, but the problem of the disposal of an effluent with such a high pH remains. With sufficient effluent dilution, no practical difficulties should arise. Kuhn had some problems with frothing at the top of the column, and anti-foam compounds were added to prevent this. The large amounts of air applied and the necessity of pH adjustment show that the method is economically prohibitive at present, and the operation requires close attention.

Another alternative approach to ammonia removal is the use of cation-exchange resin. Nesselson (1964) found that the regeneration solution amounted to at least the equivalent of 6 percent by volume of the total-flow quantity of treated sewage. Evaporation of this water for recovery of ammonium chloride in useable form is not economically attractive.

The possibility of the removal of any of the other forms of nitrogen from sewage effluents by chemical means has not been seriously considered. Nitrogen gas, not usually present at high concentrations, will be removed concurrently with the ammonia in any stripping operation. Organic nitrogen is apparently best reduced by biological methods and only nitrate and perhaps nitrite removal remains to be considered. Young et al. (1964) have screened various reducing agents with the reduction of nitrate to reduce the methemoglobinemia hazard of potable waters. Among the most effective found was ferrous hydroxide with a colloidal copper hydroxide catalyst. Limitations of the method were the long detention times required (about five hours) and the expense of the chemicals.

Biochemical Methods*

The studies on the use of organisms to remove nitrogen and phosphorus have followed two approaches: (1) Tertiary treatment with algae, and (2) modification of the activated sludge process. Developments along each of these lines are presented below.

Removal of Nutrients with Algae. Tertiary treatment of sewage with algae is well documented. The ability of algae to utilize inorganic carbon as a carbon source is a major advantage of this process since secondary effluent is high in nitrogen and phosphorus content but low in available organic carbon. This, therefore, inhibits further treatment with heterotrophic organisms. Various reports (Dugdale, 1962) (Sawyer and Ferullo, 1961) on the ability of some species of algae to fix elemental nitrogen in the laboratory and under field conditions further indicate the usefulness of these organisms for such a purpose. Phosphorus would then be the limiting micronutrient for algae growth. Tertiary treatment with algae is employed in much the same manner as the activated sludge process. A mixed population of algae in a holding pond is fed secondary effluent, allowed sufficient contact time for nutrient utilization and then the depleted water discharged into a receiving water. To insure maximum extraction of nitrogen and phosphorus, it is necessary that the bio-production per unit volume of culture be maximum.

Bogan (1961), using optimal conditions in laboratory studies, has reported high rates of orthophosphate removal - from 80-90 percent removal in 6-12 hours. This constituted removal of 20-25 ppm of the phosphate. Removal was attributed to both biological and pH effect. From these laboratory studies, a field pilot plant was constructed. This plant is unique in that a method for recovery of excess algae is included. Poor results have been attained thus far, however, due to the inability of maintaining sufficient incident light intensities. Gates and Borchardt (1964) in laboratory studies have examined various parameters such as depth, surface area and mixing to find means of enhancing the efficiency and performance of algae treatment through adequate environmental control.

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*This part of the report is primarily based on a University of Wisconsin Water Chemistry seminar paper by Rick Spear (Lee & Fruh, 1965).

From these experiments, they have concluded that the over-all controlling factor in the use of algae for waste treatment is light intensity. They have proposed the use of two-stage algae treatment. The first stage to be low algal densities to enhance high photosynthetic activity with short detention times and the second with dense populations and longer retention for final polishing. These investigators have not proposed any method for harvesting the algae although they mention it as necessary.

Field studies on algal ponds by Fitzgerald (1960) for a two-year period show average nitrogen removal throughout the year of 30 percent with maximum removals of 70 percent in the summer. Phosphorus removal during periods of maximum photosynthetic activity coincided with high pH conditions in the pond and was attributed to precipitation rather than biological removal. Fitzgerald concludes that the benefits attributed to this treatment may be offset by increased suspended solids in the effluent. Mackenthun and McNabb (1961), in reporting on stabilization pond studies in Wisconsin, essentially confirmed Fitzgerald's observations. Parker (1950) reported on the effect of passing sewage effluent through a series of eight ponds with an optimum nitrogen removal of 51 percent in the summer and 12 percent in the winter. Korbotz (1951) found the percent removal of soluble phosphorus in his artificial algal ponds at Nine Springs Treatment Plant varied directly with the ambient air temperature (presumably the water temperature varied accordingly) from a maximum of 80 percent at 75° F. to 0 percent at 45° F. In a three-month field study of dissolved solids removal, Bush et al. (1961) attained 50-70 percent inorganic nitrogen removal and 20-68 percent soluble phosphorus removal. Maximum temperature range during this study was from 65-95° F.

Neel et al. (1961) has successfully utilized algae stabilization ponds for nitrogen and phosphorus removal reporting in excess of 80 percent nitrogen removal for most of the year and 30-60 percent soluble phosphorus reduction.

Golueka and Oswald (1965) review and evaluate various methods of harvesting planktonic algae from sewage oxidation ponds. The authors point out that the entire question of the feasibility of algae harvesting depends on the existence of a market for the sewage-grown algae. Should such a market exist, communities that are forced to undertake tertiary treatment could scarcely afford not to consider algae production as a partial solution to their waste disposal problems.

Several recurring problems concerning the use of algae for nutrient removal appear throughout these reports. These problems must be overcome before algae treatment can be effectively used in nutrient removal. These are:

1. Necessity of maintaining high light intensities.
2. Inorganic carbon supply is rapidly exhausted and artificial means of supply are necessary.
3. Temperature fluctuations cause poor removal efficiency.
4. Maintenance of desired forms of algal.

5. Removal of excess or spent algal cells before release of water to receiving waters.

It is concluded that the effective use of algae for nutrient removal has not reached its proposed goal.

Removal of Nutrient by Modified Activated Sludge Process. As mentioned earlier the present activated sludge process reduces nitrogen and phosphorus content only to a limited extent. Modifications of this process to enable higher nitrogen and phosphorus removals has been investigated. Simultaneous removal of a high percentage of both nitrogen and phosphorus by these modifications has not been achieved. Conditions for the removal of nitrogen are deleterious to the removal of phosphorus and vice versa.

Several investigators present different modifications of the activated sludge process to achieve the same ends. These entail the biological oxidation of reduced nitrogen compounds to nitrate (Nitrification), with subsequent reduction to nitrogen gas (Denitrification). This induces maximum nitrogen removal but very little phosphorus uptake.

Wuhrmann (1957) (1962) reported studies conducted under both laboratory and field conditions. He used an additional tank inserted between the activated sludge and final settling basin. High rate aeration in the first tank provides conditions for complete nitrification, while the second tank induced rapid anaerobic conditions for enhancing denitrification. Efficiency of at least 90 percent removal was reported using domestic sewage of concentrations of 25-30 ppm of nitrogen. Effluent values of 2-4 ppm were recorded.

Johnson and Schroepfer (1964) have reported laboratory studies on nitrogen removal using essentially the same modifications as Wuhrmann. They found the addition of 30 percent by volume of raw sewage to the second tank was necessary to induce denitrification. They report less optimistic removal of 63-70 percent nitrogen.

Ludzack and Ettinger (1962) in a process called "the semi-aerobic activated sludge process" have divided a conventional tank into two sections with low rate aeration in the first compartment and higher rate in the second. The mixed liquor of the second section is recirculated to the first tank. This process provides for denitification on the first section and nitrification in the second. The advantage proposed over the other processes is better sludge volume indices.

The possibility of removing phosphorus from sewage effluent has long been recognized. Lea and Nichols (1936), in experiments using a supplemental organic carbon source, achieved complete phosphorus removal in three days. Sawyer (1947) achieved 98 percent inorganic phosphorus and 97 percent inorganic nitrogen removal using 80 ppm glucose supplement. Other investigators have since duplicated these findings. Two major drawbacks to this method can be cited: (1) Cost of carbohydrate supplements, and (2) increase in sludge volume.

Feng (1950), in his laboratory studies, reported increased soluble phosphorus removal in proportion to increased aeration rates. Levin (1963) has further investigated the effect of increased aeration rates and has reported removal of 3-4 ppm soluble phosphorus with three hours contact time. During these first three hours, no increase in numbers of organisms was detected. He has proposed that this is a "luxury" uptake phenomenon resulting in the formation of intracellular granules or stored phosphorus. Advantages of this method are: (1) The elimination of the necessity of the addition of organic carbon substrate, and (2) no increase in final sludge volume. Field studies have shown promise, although optimum conditions for removal were not effected. One major misgiving of this process is the loss of phosphorus to the medium after three hours and leakage cannot be stopped at any aeration rate.

It appears from these reports that modifications of activated sludge process can be effective in removing nitrogen and to some extent phosphorus but is, in general, limited to quantitative removal of only one or the other of the two nutrients.

Harvesting

The harvest of fish in Wisconsin lakes by sport fishermen undoubtedly removes a sizeable quantity of nutrients from these waters, although it has probably never been considered a benefit in this sense. From creel census records from two northern Wisconsin lakes (Escanaba Lake in Vilas County and Murphy Flowage in Rusk County), the annual harvest of sport fish ranges from 30 to 50 pounds per acre. In southern Wisconsin the harvest rate is somewhat higher. In Lake Mendota, Herman et al. (1959) estimated the harvest of yellow perch during the ice fishing season at 50 pounds per acre. Although the harvest is not known for the rest of the year, the catch of other species and the summer catch of yellow perch could likely boost this figure to 100 pounds per acre on an annual basis. Records from Cox Hollow Lake in Iowa County demonstrate the annual removal of some 50 pounds of game fish per acre (northern pike and largemouth bass) during a three-year period. It is, therefore, likely that an annual removal of 50 pounds per acre of fish by anglers is probable in fertile Wisconsin lakes.

In addition, a number of these lakes are also subject to rough fish (mostly carp) removal. For example, Helm (1951) reported in Lake Waubesa an average of 317 pounds of rough fish per acre were removed from 1936 to 1950. In Lake Mendota, some 20 to 30 pounds per acre of rough fish have been removed annually in recent years (40 lbs./acre in late 1966). It is, therefore, probable that the total removal of fish from a number of fertile Wisconsin lakes is over 100 pounds per acre annually which was also reported by Threinen (1949).

As reported by Mackenthun (1949), the nitrogen content of fish flesh (wet weight) is approximately 2.5 percent and the phosphorus content is approximately 0.2 percent. Therefore, the removal of 40 pounds of fish is necessary to remove a pound of nitrogen and 500 pounds to remove a pound of phosphorus. At a harvest rate of 100 pounds per acre annually, the removal of nitrogen and phosphorus is 2.5 and 0.2 pounds per acre, respectively.

To obtain some insight as to the significance of this removal, it is convenient to use the estimates of nitrogen and phosphorus inflow and outflow from the Report on the Nutrient Sources of Lake Mendota (1966). It is estimated that Lake Mendota receives some 47,000 pounds of phosphorus per year of which about half goes out, leaving a balance of 23,500 pounds. The nitrogen input is roughly estimated to be 550,000 pounds per year with retention of 50 to 90 percent or 225,000 to 495,000 pounds. The harvest of 100 pounds of fish per acre would remove some 2,000 pounds of phosphorus and 25,000 pounds of nitrogen per year or slightly more than 4 percent of each of these elements estimated to enter the lake. To remove half of the phosphorus entering the lake would require the annual removal of 1,175 pounds of fish per acre and 2,000 pounds per acre in the case of nitrogen, obviously impossible to attain.

The removal of aquatic plants is also looked upon as a means of nutrient removal. Recently, Gerloff and Krombholz (1966) analyzed rooted aquatics in several lakes and demonstrated a luxury uptake of nitrogen and phosphorus in fertile waters. In Lake Mendota, six species of rooted aquatics contained an average of 3 percent nitrogen and 0.47 percent phosphorus (dry weight basis). The amounts are almost twice the quantities reported by Schuette and Adler (1928 and 1929) for Lake Mendota in earlier years. On the basis of the recent results, a ton of rooted aquatics contains 7.2 pounds of nitrogen and 1.13 pounds of phosphorus. In Lake Mendota, it would take the removal of 41,000 tons of aquatics to offset the estimated input of phosphorus and 76,000 tons to offset the estimated nitrogen input. Attainment of such huge harvests is likely impossible, but it is possible to remove smaller quantities.

Livermore (1954) reported that aquatic harvesting machines are able to cut up to four tons of drained aquatic plants per hour. The City of Madison is removing close to 1,000 tons per year (Saley, 1966). Madison's experience during the last two years suggests that one ton per hour per machine is a more practical estimate for sustained harvest. The cost of operating their harvester is approximately $65 per hour (includes depreciation, maintenance, transportation, etc.), and the cost of removal of aquatics per ton is $41.

If the present removal efforts were increased to double the harvest, approximately 5 percent of the estimated input of phosphorus would be removed in Lake Mendota. This level would remove about 3 percent of the estimated nitrogen input. Among the limiting factors of aquatic plant harvesting should be mentioned the possibility of favoring greater algae blooms if significant areas of rooted aquatics are removed. Hasler and Jones (1954) report the antagonistic action of large aquatics on algae might be expected to also act in reverse.

Nees et al. (1957) in an analysis of removal methods suggest that increased harvest of rough fish is definitely possible. Initial or increased effort in aquatic plant harvesting is also possible. The combination of increased harvest methods, while not being an obvious answer to the eutrophication problem should be carefully studied in more detail for consideration as an important contribution in any program to improve water quality.

Control of Excessive Algae and Rooted Aquatic Plants

The concept of chemical control of weeds and pests has been used successfully in agriculture where obtaining the highest yield from a single crop, such as corn or wheat, has been emphasized. Here, as many competitors as possible are to be eliminated in order to enhance maximum growth. In a lake or river, on the other hand, there is a great diversity of life encompassing complex communities of plants and animals. When man-induced eutrophication sets in, the interactions among these associations are distorted. If chemicals are used to kill or prevent the growth of nuisance organisms, complex distortions take place and a chain of undesirable situations may occur. There are, as yet, no chemicals which are specific enough, in their inhibiting effect, to be used with inpunity.

Some of the chemicals used affect a variety of organisms and their delicate younger stages adversely, and some accumulate in the lake soils. It is difficult to control the influence of a chemical added to a lake or to apply it at the proper time. A great deal more research is needed to produce specific inhibiting agents which do not have undesirable side effects on other organisms and which disintegrate promptly after application. In the interim, we recommend a greater effort to harvest the surplus crops of algae, higher aquatic plants and fish, and to apply more effort in the devising of techniques to make this possible

According to Mackenthun (1959), the ideal algicide or herbicide must meet the following conditions. It must be selective; in only rare cases is the total destruction of the entire plant population desired. It must be non-toxic to fish and most fish-food organisms at the plant-killing concentration. It must not prove seriously harmful to the ecology of the general aquatic area and it must be of reasonable cost.

Palmer (1962) points out, as do others, that the most effective pattern to follow in plant and algae control is to anticipate and prevent problems rather than to delay until they become serious. This plan of attack, however, requires adequate records of the kinds, numbers and locations of the various algae and weeds in the water supply.

Of the many chemicals that have been used for the control of land plants, only a few have been utilized in aquatic weed control. Of these chemicals, sodium arsenite has been most extensively used, at least in this area. Mackenthun (1958) has described the capabilities and application of sodium arsenite. Sodium arsenite is efficacious in controlling most types of aquatic plants as well as those algae that produce pond scum. The pond scum algae, including species of Cladophora, Oedogonium and Hydrodictyon are effectively destroyed by a concentration of 5.0 ppm As_2O_3 while algae growing below the surface are not affected. Sodium arsenite is not effective against plants with a wax-like coating on their leaves, such as water lilies. Chemical treatment of this sort is generally not effective against water shield, the duckweeds, and stoneworts, muskgrass and floating-leaf pondweed.

The application rate of sodium arsenite and other herbicides is governed by many factors such as depth of the water, shape and size of the treated area and the location of the treatment area as it is affected by wind, wave action, etc.

Arsenic is highly toxic to humans and its use should also be governed by accepted tolerance limits set by the United States Public Health Service (1962) and others.

A well-known herbicide, 2,4-D, has proved successful in the destruction of water hyacinth and other emergent weeds (Eggler, 1953). Concentrations of 1,000 ppm have been sprayed on exposed leaves producing an effective kill. The residual concentration in the surrounding water will be very much less than 1,000 ppm. Alligator weed was more resistant to treatment, but weaker growths were effectively controlled with two treatments. According to McKee and Wolf (1963), the toxicity of 2,4-D to aquatic life varies widely. Many specific examples are given, but the threshold toxicity for fish is about 75 ppm.

Bruns et al. (1955) have published studies on the use of aromatic solvents for the control of aquatic weeds in irrigation ditches. In this report the solvents, which were mixtures of aromatic and cyclic hydrocarbons of either petroleum or coal tar origin, were specified by certain ASTM physical characteristics. The solvent chosen is mixed with an emulsifier and injected beneath the water surface to give a concentration of 300 to 600 ppm for 30 to 60 minutes. Eventually the emulsion will break and the solvent will evaporate, leaving the water reasonably unpolluted. Aromatic solvents are toxic to aquatic life, but do not harm crops in the concentrations used.

To date, the algicide that is in most common use is copper sulfate. Although copper sulfate is the chemical which, up to the present time, most nearly fits the specifications mentioned earlier, it does have shortcomings. According to Mackenthun (1958), copper sulfate will poison fish and other aquatic life when used in excessive concentrations and it may accumulate in bottom muds as an insoluble basic carbonate following extensive use.

The solubility of copper in water is a function of pH and alkalinity; for this reason, the application of standard toxicity tables is difficult. Also, the resistance of different organisms to copper sulfate varies widely (Goodey, 1946).

McKee and Wolf (1963) give reference on the toxicity of copper sulfate to various fish; in summary, the lethal doses range from 0.002 to 200 ppm for various fish in different waters.

Chlorine gas has been used as an algicide in some instances. The chief drawback in its use is the difficulty involved in applying the chemical to the exact spots needing treatment.

Chlorinated hydrocarbons, primarily benzenes, have been used for the control of aquatic weeds in ditches and lakes. Commercial chlorinated benzenes under the trade name Benoclor are "still" runs of chlorobenzenes consisting mainly of the trichloro isomer. The compound is sprayed under the surface of the water and forms a milky cloud that is readily absorbed by plants; the plants generally die within 24 hours after application. Aquatic animal life is destroyed by the treatment unless it is able to get out of the treatment area. Benoclor is not toxic to birds or animals. Aquatic weeds vary in their response to Benoclor with Chara and "water weed" being two types that are easily killed. Sago pondweed, coontail moss, horned pondweed and water milfoil are intermediate in response (McKee and Wolf, 1963) (Oglesby and Edmondson, 1966).

Preliminary work has been carried out on the use of chlorophenyl dimethyl urea (CMU) as an algicide (Maloney, 1958). It was concluded from the results of both laboratory and field tests that CMU at a concentration of 2 ppm prevented growth of all species of blue-green algae and diatoms and 65 percent of the green algae tested. Good results were obtained with filamentous algal growths of the types that blanket ponds and lakes and attach themselves to reservoir walls. CMU is reported to have a very low toxicity to fish and other aquatic animals at the concentrations used. Care must be exercised in the use of CMU, however, because at higher concentrations it is a soil sterilant and may destroy desirable vegetation.

It has been demonstrated that 2,3-dichloronaphthoquinone is selectively toxic to blue-green algae in concentrations of 30 to 55 ppb (Fitzgerald and Skoog, 1954). At concentration as low as 0.5 ppm, it controlled 28 percent of the blue-green algae being tested without being toxic to green algae or diatoms. No observable damage was done to fish, zooplankton or higher aquatics present.

Tests have been carried on at the R. A. Taft Sanitary Engineering Center to determine effectiveness of quaternary ammonium compounds as algicides. One of the compounds tested controlled twice as many kinds of green algae at 1 to 2 ppm as did copper sulfate. At 0.5 ppm, it controlled 29 percent of the green algae tested while copper sulfate controlled none. This chemical appeared to be less toxic to fish than copper sulfate; its 48 hours median tolerance level was 0.65 ppm as compared to 0.19 ppm for copper (Palmer, 1956).

Rosin amines have been found to be effective algicides. The rosin amine D sulfate is selectively toxic to certain diatoms while the rosin amine D acetate has more general algicidal properties. Tests showed that at 2 ppm the rosin amine D acetate controlled 90 percent of the algae present compared to 53 percent for copper sulfate. At 0.5 ppm, the amine was three times as effective as copper sulfate. Preliminary toxicity tests on fish indicated that the toxicity of the rosin amines was about the same as copper sulfate. The effectiveness of the rosin amines seems to vary with pH, hardness and other factors (Palmer, 1956).

It has been found that certain antibiotics exhibit toxic or inhibitory effects on algae. Actidione is selectively toxic to certain green algae and diatoms while streptomycin, neomycin, terramycin and certain other antibiotics are effective against blue-green algae (McKee and Wolf, 1963) (Palmer, 1956).

A recent laboratory evaluation of the effectiveness of potassium permanganate as a possible algicide for water reservoirs has been carried out (Fitzgerald, 1964). Concentrations of potassium permanganate ranging from 0.5 to 2.0 ppm gave the same results as copper sulfate in the concentration range 0.025 to 0.10 ppm. Fitzgerald points out that potassium permanganate is an algicidal rather than an algistatic agent. Fitzgerald and Faust (1963a) (1963b) have shown in laboratory tests that copper sulfate is an algistatic agent; the growth of certain algae is merely inhibited by copper sulfate and, after the copper is precipitated, these algae resume normal growth.

Potassium permanganate is not toxic to fish at the concentrations mentioned above, but it may be toxic to certain fish-food organisms (McKee and Wolf, 1963). Acrolein has been found useful in destroying water weeds, algae and snails in irrigation ditches and reservoirs in concentrations of from 3 to 6 ppm. Acrolein is generally toxic to fish at these concentrations (McKee and Wolf, 1963).

The above discussion of chemicals is intended to give a broad picture of the classes and types of compounds that are being considered and are being found effective in algae and weed control. The list of such chemicals is growing rapidly, and an increasing amount of basic and applied research is being carried out on the problem of chemical algae and weed control. The problem posed by increasing fertility and productivity is becoming more and more apparent and is creating interest in and a need for research of this type.

Other Methods*

Thomas (1963) suggests several methods of eutrophication reversal or improvement which include the harvest of plants and animals. In addition, he suggests as most important the control of nutrients that enter the waters. Other environmental techniques suggested are dilution with large quantities of nutrient-free water to flush out fertile water, drawing off nutrient rich hypolimnion water during periods of thermal stratification, and deep water aeration to mix and aerate lakes. He felt that the hypolimnion draw technique might prove most useful, but the addition of fresh water to the hypolimnion and the ventilation of the hypolimnion did not look as promising because the nutrients remained in the lake. The experience to date with continuous aeration and mixing at a current research project at Cox Hollow Lake in Wisconsin (Wirth and Dunst, 1966) suggests this method as one showing considerable promise. This 96-acre lake was destratified with several resultant water quality improvements. Further studies are necessary to evaluate permanency of these improvements with continued operation of the destratification equipment.

Many of the methods that follow in this section were proposed at one time or another for the Madison lakes. The methods are general enough that they can be and have been applied to other bodies of water. The Madison lakes merely offer a convenient example.

One of the prime causes of artificially induced eutrophication in lakes is the addition of domestic sewage and sewage effluents. In Wisconsin, the Lewis Bill which was passed in 1943 required that the sewage effluent from the metropolitan Madison area be diverted around Lakes Waubesa and Kegonsa. The treated effluent is discharged through a 5.1 mile, 54-inch concrete pipeline into a 3.8-mile open channel which empties into the Badfish Creek. The channel is provided with two cascade aerators to restore dissolved oxygen. Diversion was begun in December 1958 (Lawton, 1961). The Madison sewage diversion project is probably one of the most studied projects of its kind, but similar projects have been proposed and are being put into operation on other lakes with similar problems.

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*This section of the report is derived in part from a University of Wisconsin Water Chemistry seminar paper by Phil Kammerer (Lee & Fruh, 1965).

Lake Washington is another example of a lake that has undergone rapid eutrophication due to domestic waste pollution in recent years. Lake Washington seems capable of tolerating a maximum phosphorus input of 17 lbs./acre/year. Currently, 9 lbs./acre/year is being supplied from natural sources. Phosphorus from sewage sources has increased from about 2 lbs./acre/year in the period 1916-30 to a current level of 6 lbs./acre/year (Brown and Caldwell, 1958).

In some cases, tributaries can contribute appreciable amounts of nutrients to lakes. An example of this is cited in the Oscar Mayer Report (1955) on the Madison lakes. In the years 1942-44, an average of 10,000 pounds of inorganic nitrogen and about 3,000 pounds of organic nitrogen per month was contributed to Lake Kegonsa by Door Creek. In the month of March 1943 for example, it was found that Door Creek contributed 66,000 pounds of inorganic nitrogen and 20,000 pounds of organic nitrogen to the lake while during the same period the Madison sewage plant contributed 55,000 pounds of inorganic and 6,200 pounds of organic nitrogen. Two approaches to solving this type of problem have been suggested. One is to employ stabilization ponds to remove nutrients from the stream water. The other is to divert the stream, thus preventing the addition of the nutrients to the lake.

Another possible method of preventing nutrients from reaching a lake is the diversion of treated sewage effluent into ground waters (Oscar Mayer Report, 1955). The feasibility of this process depends on many factors. A major factor is the total nitrogen content of the effluent - a buildup in nitrogen in a ground water used extensively as a domestic water supply may cause a high enough NO_3^- level to make the water toxic to infants (methemoglobinemia). Consideration of this method of disposal must be made with caution. Such factors as the "ion exchange" capacity and percolating capacity of the soil must be considered in addition to the public health hazard involved.

The investigators in the Oscar Mayer Report (1955) feel that nuisance conditions in the lower Madison lakes could be partially alleviated by augmenting the flow through the lakes. Higher flows would cause dilution of the lake water, flushing out of stored nutrients and shorter detention periods. There are several possible methods of augmenting lake flow. One method is lake storage. In the case of the Madison lakes, this could be accomplished in a number of ways. One possibility would be to maintain a high level in the lakes during early summer and reduce the level later to increase the flow through the lower lakes.

Another method of controlling flow in the lakes is through the use of impounding reservoirs on tributaries to the lakes. One possible site for such a reservoir would be the Westport marsh area at the Yahara River inlet of Lake Mendota. Another possible site for a reservoir is a swamp area southwest of Lake Waubesa. Extensive hydrologic studies would have to be made to determine the amount of water available to fill these reservoirs. It has been suggested that it might be necessary to pump quantities of ground water or lake water into the reservoirs during the spring in order to maintain the reservoir at the desired level. The use of reservoirs has the advantage that lake levels would not fluctuate as widely as they would using lake storage.

Another possible method of supplementing lake flow is dilution with other surface water or ground water. In the Madison lakes, the cost of using well water or Wisconsin River water to augment flows in August and September appear to be more costly than impounding reservoirs or lake storage. Sylvester and Anderson (1964) propose the addition of low nutrient Seattle city water to Green Lake in Seattle for the purpose of reducing nutrient concentrations and reducing troublesome algae blooms.

Dredging of shallow areas in Lake Kegonsa and Lake Waubesa has been suggested to reduce "weed" nuisance. (Weed or weeds in this report is used to include the larger aquatic plants and rooted vegetation.) Dredging will reduce sunlight penetration with a resulting decrease in weed growths. Sylvester and Anderson (1964) have suggested similar treatment for Green Lake in Seattle.

The last method that will be mentioned in this section is irrigation. Irrigation in Wisconsin is practiced mainly with industrial wastes (canneries, packing houses and milk processing plants). Irrigation using municipal wastes is used in Europe and the southwestern United States where water is in short supply. Not only is the water beneficial for irrigation, but additional benefits may be derived from the nutrients present in the sewage effluent. Irrigation systems are difficult to operate during Wisconsin winters.

There are natural losses that may enter into an over-all nutrient balance which in a strict sense are not control methods. Nutrient nitrogen may be lost to a water by denitrification. Outlet streams may carry dissolved and particulate nutrients out of lakes. Emergent insects that leave the aquatic environment represent still another loss. These losses or reductions vary greatly and no over-all estimate of their magnitude will be made in this report.

V. IMPROVEMENTS AND PROGRAMS

Previous portions of the report discussed the problem of excessive fertilization and its apparent causes, nutrient sources and an idea of their magnitude and control methods. With these as background information, where do we go from here? Citing various approaches of determining and solving the problem and giving examples may be helpful prior to making specific recommendations.

Obviously, there is a need for further study and research. The causes and cures of excessive fertilization provide a gamut of areas for an array of disciplines. A particular problem of concern is accurately measuring or appraising eutrophication in a body of water to determine its over-all change or to compare it with another. Incorporating the various critical factors involved into a "Eutrophication Index" might be helpful.

Baseline information is necessary. Survey and inventory of our surface waters and nutrient sources are vital. Lake and stream classification and surface water monitoring are examples of two such programs. A big gap in our inventory of nutrient sources is the contribution from marshland drainage.

Legislation has been enacted for the protection of public waters. Some examples of Wisconsin legislation include: The prohibition of non-degradable detergents, s. 144.14; reporting of intended new waste sources, s. 144.555; exclusion of sewage plant effluent discharges to the Madison lakes, s. 144.05; laws relating to dams on the Wolf and Brule Rivers, ss. 30.25 and 31.30; and excluding periodically flooded areas for garbage and refuse disposal, s. 144.045. A law banning the use of phosphorus compounds in detergents might be considered as a means of reducing the amount of that nutrient reaching our surface waters. However, similar legislation recently proposed in New York and Pennsylvania didn't get past the committee stage.

Education in some cases may be helpful in gaining support and getting the job done. Such an approach might be applicable in getting sewage treatment plant operators to adopt procedures that could curb nutrient losses or in having farmers improve their land fertilization techniques.

An action program to reduce nutrients or their adverse effects in surface waters would be desirable. Diversion of effluents and storm waters from lakes into large streams would be one example. Diversion often is not practical because of the distance to a larger stream and opposition by communities or individual parties on the larger stream. For some small communities with favorable soil conditions, land disposal may provide a fairly good solution. In most cases, the development and use of tertiary treatment methods for nutrient removal appears to be the only hopeful method. Runoff from manured land is a large contributor of nutrients, particularly when the soil is frozen. Liquid manure handling holds some promise. In some areas, there is apparently little that can be done and this would include the inorganic nitrogen in ground waters.

Intensive protection and study of key waters should be instituted. Several lakes and streams having a unique property or long history should be included. The list should contain lakes with varying degrees of eutrophication as well as contrasting rivers.

Obviously, there is no single, simple solution available to solve the problem of excessive fertilization. However, our growing population and its increased per capita nutrient contributions make it expedient that we move ahead by all available means. It takes time to develop the technology, finance the improvements and put them into operation. Undoubtedly, conditions will worsen before they improve, yet they will not improve by themselves.

The previous are examples of steps and measures that might be considered to handle the problems associated with excessive fertilization of our surface waters. Specific recommendations are shown in the forepart of this report beginning on page 2.

* * * * * *

Conversion Factors

Acre = 0.4047 hectares
Cubic foot = 0.02832 cubic meters
Cubic meter = 35.315 cubic feet
Foot = 0.3048 meters
Gallon = 3.785 liters
Gram = 0.0022046 pounds
Gram/day = 0.805 pounds/year

Hectare = 2.471 acres
Kilogram/hectare = 0.892 pounds/acre
Liter = 0.2642 gallons
Meter = 3.2808 feet
Pound = 453.6 gr. or 0.4536 kg.
Pounds/acre = 1.120 kg./hectare

REFERENCES

Algae and Metropolitan Wastes Trans. of 1960 Seminar, Tech. Rept. W61-3, R.A. Taft San. Engr. Center, Cincinnati, Ohio.

Allison, E. "Nitrogen and Soil Fertility" Soil, The 1957 Yearbook of Agriculture Gov. Printing Office, Washington, D.C., 85-94 (1957).

Anon. "My Advice, Sir? Beware of De-Icers on Concrete" Milwaukee Journal (Dec. 18, 1966).

Anon. "Sohio De-Icer Heralds Use of Chemicals for Ice and Snow Removal at Airports" Chem. Engr. News, p. 24 (August 9, 1965).

Anon. "Wastewater Reuse Study" J.WPCF, 38 1, 111 (January 1966).

Baillie, E.P. (Madison Sewerage Dist.) Communications (1966).

Bartsch, A.F. "Induced Eutrophication - A Growing Water Resource Problem" Algae and Metropolitan Wastes SEC TR W61-3, R.A. Taft San. Engr. Center, Cincinnati, Ohio (1961).

Bogan, R.H. "The Use of Algae in Removing Phosphorus from Sewage' ASCE Trans. 126 231 (1961).

Braatz, D.R. "Commercial Fertilizer Summary - Wisconsin 1964-1965" State Dept. Agr. Mimeo (1965).

Brown and Caldwell, Civil and Chemical Engineers "Metropolitan Seattle Sewerage and Drainage Survey" (March 1958).

Bruns, V.F., Hodgson, J.M., Arle, H.F. and Timmons, F.L. "The Use of Aromatic Solvents for the Control of Submersed Aquatic Weeds in Irrigation Channels" U.S. Dept. Agr. Cir. No. 170, Washington, D.C. (1955).

Bureau of Sanitary Engineering with Collaboration of State Laboratory of Hygiene and Wis. State Board of Health "Public Water Supplies of Wisconsin" Madison, Wisconsin (July 1935).

Bush, A.F., Isherwood, J.D. and Rodgi, S. "Dissolved Solids Removal from Waste Water by Algae" ASCE Trans. 39-57 (May 1961).

Buswell, A.M. The Chemistry of Water and Sewage Treatment The Chemical Catalog Co.: New York (1958).

California Water Pollution Control Board "Water Reclamation in Relation to Ground Water Pollution" Publ. No. 6, Sacramento, California (1955).

Canham, R.A. "Comminuted Solids Inclusion with Spray Irrigated Canning Waste" Sew. Ind. Wastes, 30 8, 1028-1044 (August 1958).

Carmody, T. W. "Detergent Chemicals Forecast" Detergent Age, 2 1, 16-17 (June 1965).

Carrol, Dorothy Rainwater as a Chemical Agent of Geologic Processes -- A Review Geo. Sur. Water-Supply Paper 1535-G, Gov. Printing Office, Washington, D.C. (1962).

Dane County Citizens' Planning Committee Blueprint For Growth (December 1961).

Dugdale, V.A. and Dugdale, R.C. "Nitrogen Metabolism in Lakes - II. Nitrogen Fixation in Sanctuary Lake, Pennsylvania" Limn. Ocean., 7 170-177 (1962).

Eck, Jackson and Bay, Annual Report, AES Project 791 (Phase 5) (1957).

Edmondson, W.T. "Water Quality ManagementandLake Eutrophication: The Lake Washington Case" Based on papers prepared for a series of seminars at the Univ. of Washington (Spring, 1964).

Eggler, W.A. "The Use of 2,4-D in the Control of Water Hyacinth and Alligator Weed in the Mississippi Delta, With Certain Ecological Implications" Ecology, 34 409 (1953).

Eliassen, R., Wycoff, B.M. and Tonkins, C.D. "Ion Exchange for Reclamation of Reusable Supplies" J.AWWA, 57 113 (1965).

Ernest, L.A. Avalon - Industrial Waste File Communications (1954).

Ernest, L.A. (Milwaukee Sewerage Commission) Communications (1966).

Feng, T.H. "Removal of Phosphorus from Sewage Plant Effluents" Ph.D. Thesis in Civil Engr., Univ. of Wisconsin (1950).

Fitzgerald, G.P. "Stripping Effluents of Nutrients by Biological Means" Algae and Metropolitan Wastes SEC TR W61-63, 136-139, R.A. Taft San. Engr. Center, Cincinnati, Ohio (1960).

Fitzgerald, G.P. "Laboratory Evaluation of Potassium Permanganate as an Algicide for Water Reservoirs" Southwest Water Works Jour. (January 1964).

Fitzgerald, G.P. and Faust, S.L. "Bioassay for Algicidal vs. Algistatic Chemicals" Water Sew. Works, 110 8 (1963a).

Fitzgerald, G.P. and Faust, S.L. "Factors Affecting the Algicidal and Algistatic Properties of Copper" Applied Microbiology, 11 4, 345 (1963b).

Fitzgerald, G.P. and Skoog, F. "Control of Blue-Green Algae Blooms with 2,3-Dichloronaphthoquinone" Sew. Ind. Wastes, 26 1136 (1954).

Føyn, E. "Removal of Sewage Nutrients by Electrolytic Treatment" 15th Cong. Limn., Madison, Wisconsin (August 1962).

Gates, W.E. and Borchardt, J.A. "Nitrogen and Phosphorus Extraction from Domestic Waste Water Treatment Plant" J.WPCF, 36 443-462 (1964).

Gerloff, G.C. and Krombholz, P.H. "Tissue Analysis as a Measure of Nutrient Availability for the Growth of Angiosperm Aquatic Plants" Limn. Ocean., 11 529 (1966).

Goering, J.J. "Studies of Nitrogen-Fixation in Natural Fresh Waters" Ph.D. Thesis, Zoology Dept., Univ. of Wisconsin (1963).

Golueka, C.G. and Oswald, W.J. "Harvesting and Processing Sewage-Grown Planktonic Algae" J.WPCF, 37 4, 471 (1965).

Goode, F.P. (State Laboratory of Hygiene) Communication (September 1966).

Goudey, R.F. "Chemical Weed Control" J. AWWA, 38 2, 186 (1946).

Hasler, A.D. and Jones, E. "Demonstration of the Antagonistic Action of Large Aquatic Plants on Algae and Rotifers" Ecology, 30 (1949).

Helm. W.T. "An Interpretation of Rough Fish Statistics from Lake Waubesa" WCD Invest. Rept. No. 751 (1951).

Henricksen, A. "The Coagulation Process Applied to Phosphate Removal" Proc. of the Coagulation Colloquium, Water Res. Assn. (April 1963).

Hensel, E.C. "Soluble Phosphate Content of Safe and Unsafe Well Waters in Wisconsin" B.S. Thesis, Chemistry Dept., Univ. of Wisconsin (1937).

Herman, E., Wisby, W., Wiegert, L. and Burdick, M. "The Yellow Perch - Its Life History, Ecology, and Management" WCD Publ. 228 (1959).

Hurwitz, E., Beaudoin, R., and Walter, W. "PHOSPHATES Their Fate in a Sewage Treatment Plant -- Waterway System" Wat. Sew. Works, 112 3, 84 (March 1965).

Ingraham, S.H. "Removal of Algal Nutrients from Domestic Wastewater: Part I. Literature Survey" New York State Dept. of Health, Rept. No. 11, Part I. (November 1964).

Johnson, W.K. "Nutrient Removals by Conventional Treatment Processes" Proc. 13th Ind. Wastes Conf., Purdue Univ., Ext. Ser., 96 151 (1958).

Johnson, W.K. and Schroepfer, G.J. "Nitrogen and Phosphorus Removals by Conventional Treatment Processes" San. Engr. Prog. Rept. 104S, Univ. of Minnesota, Minneapolis (September 1956).

Johnson, W.K. and Schroepfer, G.J. "Nitrogen Removal by Nitrification and Denitrification" J. WPCF, 36 1015-1036 (1964).

Katz, W.J. "The Chemical Removal of Phosphorus from Sewage Effluents" M.S. Thesis in Civil Engr., Univ. of Wisconsin (1949).

Keefer, C.E. Sewage Treatment Works 1st ed. McGraw-Hill Book Co.: New York (1940).

Korbitz, W.D. "Removal of NH_3-Nitrogen from Sewage Effluent" M.S. Thesis in Civil Engr., Univ. of Wisconsin (1951).

Kuhn, P.A. "Removal of Ammonia Nitrogen from Sewage Effluents" M.S. Thesis in Civil Engr., Univ. of Wisconsin (1956).

Larson, T.E. and Hettick, I. "Mineral Composition of Rainwater" Illinois State Water Sur. Circ. No. 56 (1956).

Lawton, G.W. "The Madison Lakes Before and After Diversion" in Algae and Metropolitan Wastes Tech. Rept. W61-3, R.A. Taft San. Engr. Center, Cincinnati, Ohio (1961).

Lawton, G.W., Engelbert, L.E., Rohlich, G.A., and Porges, N. "Effectiveness of Spray Irrigation as a Method for the Disposal of Dairy Plant Wastes" Univ. of Wisconsin, Engr. Res. Rept. No. 15 and Agr. Expt. Sta. Res. Rept. No. 6, Madison, Wisconsin (1960).

Lea, W.L. and Nichols, M.S. "Influence of Substrate on Biochemical Oxygen Demand" Sew. Works, 8 435 (1936).

Lea, W.L., Rohlich, G.A. and Katz, W.J. "Removal of Phosphates from Treated Sewage" Sew. Ind. Wastes, 26 261 (1954).

Lee, G.F. and Fruh, E.D.(ed.) "Eutrophication of Natural Waters" Water Chemistry Seminar, Univ. of Wisconsin. Mimeo (1965).

Lerch, W. "WARNING! Use the Right De-Icer" Modern Concrete (May 1962).

Levin, G.V. Reducing Secondary Effluent Phosphorus Concentration Prog. Rept PHS Grant WP-99, Dept. of San. Engr. & Water Res., The Johns Hopkins Univ. (April 1963).

Livermore, D.F. "Harvesting Underwater Weeds" Water Works Engr., 107 2, 118(1954).

Ludzack, F.J. and Ettinger, M.B. "Controlling Operation to Minimize Activated Sludge Effluent Nitrogen" J.WPCF, 34 9, 920 (1962).

Mackenthun, K.M. "The Chemical Control of Aquatic Nuisances" Wis. Comm. on Water Poll., Madison, Wisconsin (1958).

Mackenthun, K.M. "Summary of Aquatic Weed and Algae Control Research and Related Activities in the United States" Wis. Comm. on Water Poll., Madison, Wisconsin (1959).

Mackenthun, K.M. "A Review of Algae, Lakes and Nutrients" J.WPCF, 34 10, 1077-1085 (October 1962).

Mackenthun, K.M. Nitrogen and Phosphorus in Water U.S. Dept. H.E.W., PHS (1965).

Mackenthun, K.M. and Ingram, W.M. Limnological Aspects of Recreational Lakes PHS Publ. No. 1167, U.S. Dept. of H.E.W., Washington, D.C. (1964).

Mackenthun, K.M. and McNabb, C.D. "Stabilization Pond Studies in Wisconsin" J.WPCF, 33 12, 1234-1251 (December 1961).

Malhotra, S.K., Lee, G.F. and Rohlich, G.A. "Nutrient Removal from Secondary Effluent by Alum Flocculation and Lime Precipitation" J.AWP, 8 487 (1964).

Maloney, T.E. "Control of Algae with Chlorophenyl Dimethyl Urea" J.AWWA, 50 3, 417 (1958).

Maloney, T.E. "Detergent Phosphorus Effect on Algae" J.WPCF, 38 1, 38-45 (1966).

McCord, G.K. (Portland Cement Assn) Personal Communication (December 1966).

McKee, J.E. and Wolf, H.N. Water Quality Criteria 2nd ed., State Water Quality Control Board, Sacramento, California, Publ. 3-A (1963).

Merrill, J.C.Jr. and Katko, A. "Reclaimed Wastewater for Santee Recreational Lakes" J.WPCF, 38 8, 1310-1318 (August 1966).

Midgley and Dunklee, Bul. 523, Agr. Exp. Sta., Univ. of Vermont (1945).

Milwaukee Metropolitan Sewerage Commission "Jones Island Plant Operating Data for 1965".

Neel, J.K., McDermott, J.H. and Monday, C.A.Jr. "Experimental Lagooning of Raw Sewage at Faueh, Missouri" J.WPCF, 33 603 (1961).

Neess, J.C., Helm, W.T. and Threinen, C.W. "Some Vital Statistics in a Heavily Exploited Population of Carp" J. Wildlife Mgmt., 21 279 (1957).

Nesselson, E.J. "Removal of Inorganic Nitrogen from Sewage Effluents" Ph.D. Thesis in Civil Engr., Univ. of Wisconsin (1954).

Nichols, M.S. (Emeritus Prof. of San. Chem.) Communications (1966).

Nutrient Sources Subcommittee of the Technical Committee of the Lake Mendota Problems Committee "Report on the Nutrient Sources of Lake Mendota" Madison, Wisconsin (1966).

Oglesby, R.T. and Edmondson, W.T. "Control of Eutrophication" J.WPCF, 38 1391-1562 (1966).

Oscar Mayer and Company "The Madison Lakes Problem" Part II (September 15, 1955).

Owen, R. "Removal of Phosphorus from Sewage Plant Effluent with Lime" Sew. Ind. Waste 25 548 (1953).

Palmer, C.M. "Evaluation of New Algicides for Water Supply Purposes" J. AWWA, 48 9, 1133 (1956).

Palmer, C.M. Algae in Water Supplies PHS Publ. No. 657, Supt. of Documents, Washington, D.C. (1962).

Parker, C.D., Jones, H.C. and Taylor, W.S. "Purification of Sewage in Lagoons" Sew. Ind. Wastes, 22 6760 (1950).

Preul, H.C. "Underground Movement of Nitrogen" J.WPCF, 38 3, 335-336 (March 1966).

Provasoli, L. "Micronutrients and Heterotrophy as Possible Factors in Bloom Production in Natural Waters" in Algae and Metropolitan Wastes SEC TR W61-3, R.A. Taft San. Engr. Center, Cincinnati, Ohio (1961).

Public Health Service Drinking Water Standards, U.S. Dept. of H.E.W. (1962).

Rafter, G.W. and Baker, M.N. Sewage Disposal in the United States 2nd ed. D. Van Nostrand Company: New York (1894).

Rohlich, G.A. "Methods for Removal of Phosphorus and Nitrogen from Sewage Plant Effluents" J.AWP, 7 427 (1963).

Rudolfs, W. "Phosphates in Sewage and Sludge Treatment - I. Quantities of Phosphates" Sew. Works Jour., 19 1, 43-47 (January 1947).

Rudolfs, W. and Heinemann, B. "Growth-Promoting Substances in Sewage and Sludge - I. Review of Literature" Sew. Waste Jour., 10 4, 643 (July 1938).

Saley, B. (Madison City Health Department) Personal Communications (1966).

Sanderson, W.W. "Studies of the Character and Treatment of Waste from Duck Farms" Proc. 8th Ind. Waste Conf. Purdue Univ., 38 1, 170-176 (1953).

Sawyer, C.N. "Fertilization of Lakes by Agricultural and Urban Drainage" J. New Engl. Water Works Assn., 61 109 (1947).

Sawyer, C.N. Chemistry for Sanitary Engineers McGraw-Hill Book Company, Inc.: New York (1960).

Sawyer, C.N. and Ferrullo, A.F. "Nitrogen Fixation in Natural and Laboratory Conditions" Algae and Metropolitan Wastes W61-63, p. 100, R.A. Taft San. Engr. Center, Cincinnati, Ohio (1961).

Sawyer, C.N. Lackey, J. B. and Lenz, A.T. "Investigations of the Odor Nuisance Occurring in the Madison Lakes" Madison, Wisconsin (1943-1944).

Sawyer, C.N., Lackey, J.B. and Lenz, A.T. "Investigation of the Odor Nuisance Occurring in the Madison Lakes, Particularly Lakes Monona, Waubesa and Kegonsa from July 1943 to July 1944" Rept. to the Governor's Comm., Madison, Wisconsin (1945).

Schraufnagel, F.H. "Chlorides" Wis. Comm. Water Poll., Madison, Wisconsin (August 1965).

Schuette, H.A. and Alder, H. "Notes on the Chemical Composition of Some of the Larger Aquatic Plants of Lake Mendota" II. Tran. Wis. Aca. Sci., Arts, Letters, 23 249 (1928) and III. 24 135 (1929a).

Scott, R.H. "The Reduction of Soluble Phosphorus in Sewage Plant Effluents" Ph.D. Thesis in Civil Engr., Univ. of Wisconsin (1947).

Seesing, J. R. "The Physical and Chemical Properties of Soils and Growths of Plants as Affected by Irrigation with Sewage Effluent" Ph.D. Thesis, Univ. of Wisconsin (1961).

Shah, K.S. "Sulfur and Nitrogen Brought Down in Precipitation in Wisconsin" M.S. Thesis, Soils Dept., Univ. of Wisconsin (1962).

Sharratt, W.J., Peterson, A.E. and Calbert, H.E. "Whey as a Source of Plant Nutrients and its Effect on the Soil" J.Dairy Sci. 42 7, 1126-1131 (July 1959).

Sherman, J.V. "Phosphorus Chemicals" Barron's (October 12, 1966).

Stahl, E.H.A. "Development and Uses of Ground Water Supplies" J. AWWA, 57 9, 1123 (September 1965).

Sylvester, R.O. Limnological Aspects of Recreational Lakes PHS Publ. 1167 (1960).

Sylvester, R.O. "Nutrient Content of Drainage Water from Forested, Urban and Agricultural Areas" in Algae and Metropolitan Wastes SEC TR W61-3, R.A. Taft San. Engr. Center, Cincinnati, Ohio (1961).

Sylvester, R.O. and Anderson, G.C. "A Lake's Response to its Environment" ASCE San. Engr. Div. 90, SA 1, Part I (February 1964).

Tanner, C.B. Mimeo, Soils Dept., Univ. of Wisconsin (1966).

Thomas, E.A. "Die Veralgung von Seen and Flüssen, deren Vrsache und Abwehr" Monatsbull. Schweiz. Ver. Gas- und Wasserfachm., Nr. 6/7, 12s. (1963). (The Eur rophication of lakes and streams, their cause and prevention.)

Threinen, C.W. "An Analysis and Appraisal of the Rough Fish Problem of Wisconsin" WCD Invest. Rept. No. 715 (1949).

U.S. Bureau of the Census Statistical Abstract of the United States: 1965 86th ed., Washington, D.C. (1965).

U.S. Bureau of the Census "Census of Manufacturers, 1963 Industry Statistics: Cleaning and Toilet Products" MC63(2)-28D. U.S. Gov. Printing Office, Washington, D.C. (1966).

Vacker, D., Connell, C.H. and Wells, W.N. "Phosphate Removal Through Municipal Wastewater Treatment at San Antonio, Texas" Presented at the annual short school of the Texas Water and Sewage Works Assn., Texas A & M University (March 9, 1966).

Warrick, L.F., Wisniewski, T.F. and Sanborn, N.H. Bull. Wis. State Board of Hlth and Natl. Canners Assn. p. 27 (1945).

Weibel, S.R., Anderson, R.J. and Woodward, R.L. "Urban Land Runoff as a Factor in Stream Pollution" J. WPCF, 36 7, 914-924 (July 1964).

Wirth, T.L. and Dunst, R.C. "Limnological Changes Resulting from Artificial Destratification and Aeration of an Impoundment" 28th Midwest Fish. Wildl. Conf. (December 1966).

Wirtshafter, Z.T. Minerals in Nutrition Reinhold Publishing Corporation: New York (1942).

Wisconsin Comm. on Water Pollution "A Review of Chemical Monitoring on Badfish Creek and Lower Receiving Rivers 1960-1965" Madison, Wisconsin (June 1966).

Wisconsin Department of Resource Development Land Use in Wisconsin (1963).

Wisconsin Geological Survey, Personal Communications (1966).

Woodburn, J.G., Polk, W.J. and Nelson, G.A. "Thirty-sixth Annual Report of the Commissioners of Madison Metropolitan Sewerage District for the Calendar Year 1965."

Woodruff, C.M. "Estimating the Nitrogen Delivery of Soil from the Organic Matter Determination as Relected by Sanborn Field" Soil Sci. Soc. Amer. Proc. 14 208-212 (1949).

Wuhrmann, K. "Tertiary Treatment" Sweiz, Z. Hydrol., 19 409 (1957).

Wuhrmann, K. "Nitrogen Removal in Sewage Treatment Processes" Verh. Internat. Limn. 15 580-596 (1962).

Young, G.K., Bungay, H.R., Brown, L.M. and Parson, W.A. "Chemical Reduction of Nitrate in Water" J.WPCF, 36 395 (1964).

It is suggested, sometimes blithely and blandly --

MR. STEIN: Is that blandly or blindly?

(Laughter.)

MR. HOLMER: -- that Wisconsin, Michigan and Indiana should divert their municipal and industrial wastes outside the basin of the Lake. Mr. Klassen addressed himself to this problem earlier. Such a response to the problems of pollution--divert the burden to someone else--cannot be entertained lightly. The initial and operating costs would be substantial. The analysis of costs and benefits, and consideration of the kinds of institutional arrangements required, thinking in terms of the numbers of industries and municipalities that would be involved in such an arrangement, would be an essential prerequisite to further consideration of such a proposal. A decision of this magnitude can, of course, be made only in the light of consideration of all of the consequences and all of the alternatives.

Let me reiterate, this is a suggestion which is often made. It is not rejected out of hand. It, as well as all of the other alternatives that are open to us as we face this crisis, need to be considered fully and carefully and completely to assure that we do deal with the problem in the way that measures up to the best knowledge we have.

The key to the success of the conference will lie in our ability to deal, in an organized and comprehensive fashion, with the complexity of the problem. Wisconsin takes pride, as you heard yesterday from Governor Knowles, in its Water Resources Act precisely because it seeks to approach water quality and water management with a coordinated program. That program requires such elements as comprehensive planning, shoreland and flood plain zoning and the mandatory training and certification of sewage treatment plant operators. They are described in our application for a program grant submitted to the Federal Water Pollution Control Administration. We think that this has many suggested items that the Conferees ought to be aware of and to consider in dealing with this comprehensive problem. Efforts of the kind described in the application are essential to supplement the more customary pollution abatement activities. It is, therefore, requested that the formal statements of Wisconsin flood plain and shoreland management programs also be incorporated in the Conference record and that the Conference consider recommendations on these subjects of shoreland and flood plain zoning. We are confident in Wisconsin that the control of the land usage adjacent to streams and lakes is a critical key to the effective prevention of pollution as well as to its abatement, and we think that this deserves attention.

I would suggest, too, that another item with which we are involved in Wisconsin, and all of us in the other States as well, is in the area of the private sewage disposal facilities, which I think we need to speak to rather explicitly when we come to the development of our Conference Report and summary.

On Thursday, with the concurrence of members of the Conference, I distributed to the Conferees what we called an Opening Statement. It was a kind of a working document which I submitted to the Conferees suggesting what seemed to us in Wisconsin to be the appropriate contents of the Summary Report of this Conference and made some suggestions with respect to the sequence with which we ought to approach the development of our recommendations. I wanted to do this for several reasons. That Opening Statement suggests that in the Summary Report of this Conference there should be a somewhat more extensive treatment than is offered in the FWPCA's working document relacing to the nature of delays in dealing with this problem. We are hopeful and confident of the success of the efforts in which we are engaged, but we are also concerned that we make it clear to the people of these four States that there are necessary steps which must be taken in sequence and that there will be a significant period before the effects of some of the steps which we are proposing to take will be effective, that they will in fact achieve the results for which we all hope.

And so it is necessary to include, we would suggest, in the Summary Report of this Conference a general description of the kinds of lead times that are required for engineering and construction and,where necessary,research, that we identify the research gaps and the kinds of time that will be required to fill them. We must deal, it seems to me, with the problem of the shortages of technical personnel and in those areas where legislative action is required some idea of legislative lead time. We need to address our attention to the simple magnitude of the task that is involved in such areas as sewer separation and those areas which are involved in the combination of municipal and industrial treatment or inter-municipal waste treatment, which is one of the recommendations in the FWPCA Report and which will obviously require a somewhat longer period of gestation than is required for some of the other facets of this problem we are coming to grips with.

As we consider the alternatives before us, let me suggest that we seek to agree, first, in the areas where our present knowledge is inadequate, to establish a set of specific research priorities and rigorous schedules for implementation of new procedures resulting from such research. Next, we should seek agreement on the standards to govern our handling of the problems for which present technology offers practical guides (as in the handling of municipal and industrial wastes). Then we should seek concurrence with respect to our respective responsibilities in areas where our knowledge is less certain (as in control of alewives) but where promising alternatives appear to be available.

And may I suggest also in reiteration that we bear in mind as we proceed with our deliberation the necessity for establishing priorities on our needs and our actions as was suggested by Governor Knowles yesterday.

The national interest in the problems of the Lake Michigan Basin would appear to warrant a substantial Federal investment in those areas where more knowledge is needed. Especially in the Green Bay area, where a commercial fishery is at stake, a Federally-financed pilot project, supplementing present research efforts, may be in order.

In Wisconsin, the application of present technology to the handling of municipal and industrial wastes will proceed as rapidly as is possible. We are committed to doing so. The cost of dealing with the nutrient enrichment of the Lake, however, computed on the basis of known technology, is widely regarded as prohibitive. At least it was two weeks ago. But "prohibitive" is a relative word. If research now underway fails to produce significant breakthroughs in the near future we suggest that this Conference also seek agreement on the means to be considered for future action on this problem. I would modify that to conform with what I had to say earlier on this subject.

Our environment is in delicate balance. Man can alter it significantly but we dare not alter it beyond our power to reverse our own errors. And let us not deceive ourselves. We face a long and costly struggle and we cannot succeed fully without using tools that either do not yet exist or are now viewed as impractical. To succeed we must be aggressive and persevering. Constant vigilance is not only the price of liberty; it is also a part of the price of survival.

MR. STEIN: Thank you, Mr. Holmer, for a very excellent statement.

Do we have any comments or questions?

MR. JAHNKE: Could I ask him a question?

MR. STEIN: We don't take any questions from the floor. I am sorry. If we threw this open to the floor, I think we would get a permanent lease on the hotel.

Are there any other questions or comments?

MR. POSTON: I would like to ask Mr. Holmer, in the first part of his paper, as I understand this there will be set intrastate standards on intrastate waters in the State of Wisconsin and that you would expect to achieve these standards in 10 years? Is this --

MR. HOLMER: Let me clarify that because it is a more far-reaching statement than appears on its face. Indeed, there are those in Wisconsin who have serious doubts as to whether it is possible to achieve the goal as stated here within 10 years.

"The long-range goal of Wisconsin intrastate standards...is to permit the use of water resources for all lawful purposes, including the reproduction of game fish and minnows."

This is our highest standard of use. And we have adopted as our own internal challenge the achievement of this objective within 10 years. This is more than we have promised anybody else but ourselves.

MR. STEIN: This goes above and beyond that.

MR. HOLMER: Yes, sir.

MR. STEIN: Are there any other further comments or questions?

I think you have a very constructive statement here, and in looking at all these I think we are very close together, but necessarily because of the complexity of this all the four States have come in with something slightly different. I think we have a real challenge in trying to get our programs dovetailed to meet the Lake Michigan Conference.

Are there any other questions?

(No response.)

MR. STEIN: Do you have any further people from Wisconsin?

MR. HOLMER: We do not.

MR. STEIN: You do not.

We have consulted with the Conferees, and because of driving conditions--I will take the blame for this; Mrs. Rankin calls me a slave driver--we are going to go right through. I am just calling a recess now for 10 minutes. We will reconvene at that time and the next thing we will take up will be the Federal Conclusions and Recommendations which have been presented by Mr. Robert Schneider earlier. We deferred comment on these until now.

Before that, I do think that Mr. Poole has a statement to make.

INDIANA PRESENTATION (CONTINUED.)

MR. POOLE: I have a statement here that has been handed in this morning by Mr. H. LaBrant, of Whiting, Indiana, which I would merely like to enter into the record, Mr. Chairman, without reading it.

MR. STEIN: Thank you.

(Which said statement is as follows:)

STATEMENT OF H. LaBRANT
WHITING, INDIANA

February 6 press reports allege that the State of Indiana produces the majority of the pollution of Lake Michigan. This places great importance on the acts of the City of Hammond, Indiana, which has dumped most of this pollution into Lake Michigan.

The acts of the City of Hammond have nullified hundreds of millions of dollars of construction of the Sanitary District Cal-Sag Canal designed to scavenge the domestic and industrial

STATEMENT OF H. LaBRANT

wastes of the Calumet District of Indiana by drainage of the Calumet Rivers.

The City of Hammond, Indiana, has diverted the majority of the industrial and domestic filth of Gary, East Chicago, Indiana Harbor, and Hammond, Indiana, from the Cal-Sag Canal and dumps it into Lake Michigan.

The enormity of the pollution contribution by the City of Hammond and the relative ease, speed, and low cost of reversing this pollution diversion makes it difficult to understand why public exposure of this gross pollution has been suppressed.

While all water pollution must be condemned and corrected, if we must choose between the temporary pollution of a stream or a lake we should choose the stream because a stream can be flushed and rejuvenated, a lake cannot. If we must choose between emptying Calumet area wastes into Lake Michigan or the Cal-Sag Canal, it should be the Cal-Sag.

Three Indiana steel mills reported by the press to be the greatest polluters of Lake Michigan were scavenged by the Grand Calumet River and the Cal-Sag Canal before the unjustifiable acts of the City of Hammond diverted these and other industrial and domestic pollutants into Lake Michigan.

Eleven years ago the City of Hammond, Indiana, desired to replace the two-lane Columbia Avenue Bridge across the Grand Calumet River with a four-lane "causeway fill" to save the cost of a bridge and petitioned the Corps of Engineers for permission to dam the river which had been navigated and had many lift bridges.

A remonstrance against permitting the dam across the Grand Calumet River was presented at the Corps of Engineers hearing alleging that the culverts proposed were inadequate to carry the flow, that they would become silted and obstructed resulting in diversion of most of the polluted wastes this stream carried into Lake Michigan thru the Indiana Harbor Ship Canal.

The Colonel in charge of the hearing agreed that diversion of pollution into Lake Michigan would probably result, but stated he had to reject the remonstrance because the Corps of Engineers was authorized by law only to consider the effect on navigation and flood control, not pollution and public health, safety, and welfare. Certainly

STATEMENT OF H. LaBRANT

Congress should promptly correct this limitation; water pollution and public health are more important considerations than the navigation of a coal barge.

The silting and obstruction of the culverts by debris and vegetation has exceeded the expectations of the remonstrators. As a consequence, near the Illinois-Indiana State line the formerly navigable Grand Calumet River has been reduced by the Hammond Dams to an ankle deep, six foot wide creek with little current. By contrast, the outflow from the Grand Calumet River in the Indiana Harbor Ship Canal at the Columbus Drive Bridge is navigable by Great Lakes freighters and has a strong current rushing out into Lake Michigan and carrying most of the Calumet area pollutants.

This can be reversed by removing the Hammond Dams and placing a temporary coffer dam across the Indiana Harbor Ship Canal near Columbus Drive to force hydraulic cleaning of the silted Grand Calumet channel caused by the Hammond Dams.

Positive flow in the Indiana Harbor Ship Canal away from Lake Michigan can be provided with a large volume low head screw or other type of irrigation pump to move water past the coffer

STATEMENT OF H. LaBRANT

dam until locks are built at the mouth of the Indiana Harbor Ship Canal to protect Lake Michigan, similar to the protecting locks at the mouth of the Chicago River.

(Signed) H. LaBrant
Whiting, Indiana

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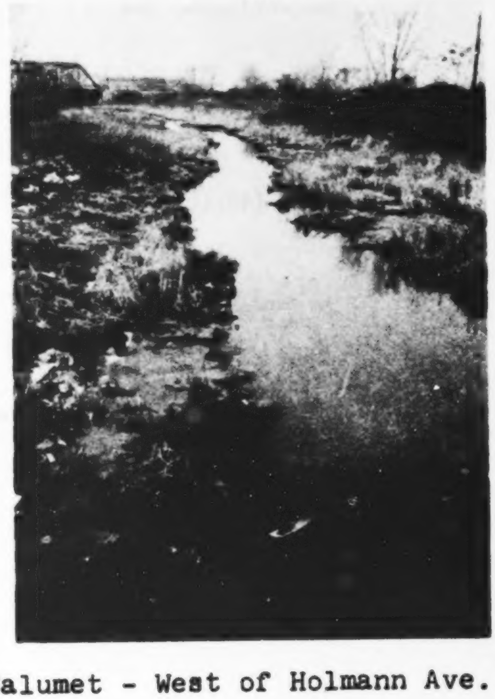
(The following photograph was submitted by H. LaBrant:)



Grand Calumet - West of Holmann Ave. bridge

MR. STEIN: Do you have any other statement to introduce?

FEDERAL PRESENTATION (CONTINUED.)

MR. POSTON: We have, I think, about two statements, Mr. Cook has those, that I would like to distribute to the Conferees at this time and have them introduced into the record.

MR. STEIN: These statements will be distributed and entered into the record, if there is no objection, as if read. And if I hear no objection, I am presuming they will be entered into the record.

(Which said statements are as follows:)

STATEMENT OF
FEDERAL COMMITTEE ON PEST CONTROL

8120 WOODMONT AVENUE
WASHINGTON, D.C. 20014

February 2, 1968

FEDERAL COMMITTEE ON PEST CONTROL

Mr. Grover Cook
Great Lakes Region
Federal Water Pollution Control
  Administration, USDI
33 East Congress Parkway, Room 410
Chicago, Illinois 60605

Dear Mr. Cook:

It was a pleasure to attend the first two days of the Enforcement Conference on the Pollution of Lake Machigan and I wish that I could have stayed longer.

There was a question asked following Dr. Carbine's report at the close of the day on Thursday, February 1, which I felt should have further comment. However, the time of day was not propitious for an extended gratuitious answer from the floor. Nevertheless, the following comments may be of interest to the panel if it is not too late to insert them into the record.

Dr. Carbine had indicated that the present levels of pesticides in Lake Michigan were not yet at a critical level but some of them were approaching such levels. Mr. Klassen asked, What are considered lethal levels of pesticides and how are they determined? The answers given by Dr. Carbine and Mr. Stein were correct, since it is true that no satisfying simple answer can be given to this question. Nevertheless, it would be unfortunate to leave the panel with the impression that little or nothing is known on this important subject. The facts are that a great deal of excellent research, both in the laboratory and in the field, has been done on hazards to fish and other aquatic organisms from a variety of pesticides. Much of the data on EC 50's (the concentration which produces the expected effect in 50 per cent of the test population) have been gathered and are being evaluated by the National Technical Advisory Committee to the Federal Water Pollution Control Administration on Water Quality Criteria. However, all of this research does not provide a straightforward simple answer to such a generalized question as, What is the lethal level of pesticides?, because the problem is far more complex than is implied in the question. In the first place, there are a wide variety of pesticides each with its own toxic characteristics. Secondly, with many different species of fish some of them will have a very different sensitivity to pesticides than do others. Moreover, fry are frequently much more sensitive than are more mature fish. For example, in some species of fish the fry may be especially sensitive to certain formulations of the weed killer 2,4-D but quite resistant to other forms of the same weed killer. Another important fact is that most of the pesticides of especial interest have extremely low solubility in water. Nevertheless, they may adhere to particles and contaminate the sediment on the bottom. Moreover, they will be concentrated in various organisms in the food chain. Therefore, the most significant hazard to fish under certain circumstances might be due to the effect upon the food chain rather than because of their direct toxicity to fish.

If I might be permitted to offer some interpretations, I would suggest that these complications should not be a cause for despair or for insisting on a simple though possibly inadequate answer. Rather, I believe that the excellent scientists who are currently studying this problem, both in the four States involved in the Conference and in the Federal Government, should be encouraged to continue if not expand their studies. At the same time, efforts to find substitutes for the toxic pesticides should be continued or expanded and techniques should be sought to reduce the contamination of lakes and streams by such pesticides. Advantage should be taken of the fact that the levels in Lake Michigan are not yet critical so that an orderly solution to this problem can be found.

The potential danger of a premature solution might be illustrated by the current claims in the cotton growing areas of the Southwest that restrictions on the use of persistent chlorinated hydrocarbon pesticides have resulted in more severe damage to the environment than would have occurred from DDT. Specifically, two non-persistent pesticides, carbaryl and azodrin, have been used in place of DDT for the control of certain cotton insects. Carbaryl, a carbamate, does not persist in the environment but it is extremely toxic to honeybees and it is claimed that it has nearly wiped out bees and other important pollinators from wide areas. Similarly, azodrin, an organic phosphorus insecticide, likewise disappears rapidly from the environment but is nevertheless very toxic to certain birds and has killed large numbers of quail and doves in these cotton growing areas.

I have no factual data on the accuracy of these reports but they sound reasonable and illustrate my suggestion that we should not risk an unknown danger in order to forestall a known danger which has not yet reached critical proportions. Rather we should take advantage of the grace period still remaining before us to find more desirable alternatives.

I will be looking forward to the recommendations of this Conference with a great deal of interest. I am sorry that I could not remain through the balance of the presentations.

Sincerely yours,

William M. Upholt, Ph.D.
Executive Secretary
Federal Committee on Pest Control

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STATEMENT OF VERNE M. BATHURST

STATEMENT BY VERNE M. BATHURST
STATE CONSERVATIONIST, SOIL CONSERVATION SERVICE
EAST LANSING, MICHIGAN

Mr. Chairman:

I appreciate this opportunity to make a statement at this Conference. The U. S. Department of Agriculture and the Soil Conservation Service have an interest in pollution problems, particularly as they relate to pollution from sediment.

The Soil Conservation Service (SCS) is the U. S. Department of Agriculture technical arm of action for soil and water conservation. It cooperates closely with Federal and State agencies that deal with loans, cost-sharing, fish, wildlife, recreation, and other matters related to land and water use.

We stand ready to cooperate in any way which we can to control erosion and thereby reduce pollution by sediment in Lake Michigan.

The problem of water pollution, especially that caused by sediment, cannot be dealt with effectively without considering the lands upon which it falls. The treatment of those lands is a primary concern to the Soil Conservation Service.

The discharge of sediment into water supplies has, in the past, often been associated with only agricultural lands. This is no longer true.

Serious erosion, sediment production, and resulting pollution occurs on lands used for any and all purposes -if those lands are left unprotected. There is evidence that major sediment deliveries are taking place in our streams and lakes within the Lake Michigan drainage area from other than agricultural lands. This is particularly true of those areas of suburban and industrial development near our major cities, many of which are in close proximity to water areas. The same is true to a large degree of any industrial, municipal, or recreational development which includes scarifying the land and leaving it uncovered to the ravages of erosion during periods of construction. The extent of the severity of sedimentation will depend upon the erosiveness of the soil, the length of time which the soil is left exposed, the season which it is exposed, and the topography in the area, plus the proximity to streams or lakes.

Excessive sediment is essentially harmful to all beneficial uses of water. The cost of filtration of water for domestic and industrial uses generally exceeds all other costs. Sediment smothers and inhibits aquatic life and greatly reduces the recreation potential of the Nation's lakes, streams, and reservoirs. It fills streams, channels and lakes, requiring costly maintenance. It impairs the oxidation of organic pollutants in streams. Sediment causes erosion of power turbines, pumping equipment, and other structures.

The quality of our water depends upon how it is treated from the time it falls as precipitation. Since practically all of our precipitation falls on land. The treatment that it receives has a major bearing on water quality.

The treatment measures of which I speak are those which reduce the velocity of water to the point where it will not carry significant amounts of sediment. Also important are those measures which provide sufficient cover for the land to prevent the dislodging of soil particles which later become detrimental sediment in our lakes, rivers, streams, such as Lake Michigan and its tributaries.

The same practices which have so

effectively controlled erosion on agricultural lands can, with modification, be applied to all other land uses where erosion is a problem. The same principles apply in either case.

All sources of sediment must have unified, coordinated attention if we are to overcome this threat to our water resources. Whether the sediment source is farmland, surface-mined areas, roadsides, streambanks, or from land being converted to urban or industrial uses; the greatest progress can be made when all interests, public and private, in a drainage area unite their efforts. Attempts to deal with the problems piecemeal are costly and in many instances ineffective. Many land users, public and private, have not fulfilled their responsibility toward pollution abatement through sediment control.

Preliminary studies in Michigan indicate that as much as 100 tons of soil per acre per year were being eroded from sites undergoing urban development. This is twenty times that considered an acceptable loss from agricultural land. Soil can be conserved in place for three to five cents per cubic yard. The costs of removing sediment from water or streambeds are many times higher.

STATEMENT OF VERNE M. BATHURST

The Soil Conservation Service and the U. S. Department of Agriculture has a wealth of experience and skill in dealing with soil, water, plants, and animals - the basic resource elements in our environment. Limited as the programs are for dealing with roadsides, streambanks and surface-mined areas, we have knowledge and skills that can be applied to these sources of sedimentation and pollution. This knowledge and skills are those which have been developed in carrying out an effective nationwide soil and water conservation program.

Much has been and is being done to correct erosion problems. The Soil Conservation Service works closely with soil conservation districts. These districts, which are local entities of State Government, provide local leadership for soil and water conservation programs. The Service also cooperates closely with planning commissions, land use boards, health officials, county governments, and others by providing soils information and technical counsel in erosion control and the wise use of land.

Our soil scientists conduct soil surveys to determine the erosiveness, and other characteristics of the individual soils. Soil Conservation Service soil conservationists then develop conservation plans, with the landowner, which spell out the conservation practices necessary to control erosion and excessive runoff. This assistance is available to all landowners and land users - be they individual or group, public or private. Technical assistance is then provided as necessary in the installation of the needed conservation measures. Other agencies within the Department can in some cases provide cost-sharing or loans for conservation measures.

Soil Conservation Service engineers have worked closely with the Bureau of Public Roads to develop guidelines for minimizing possible soil erosion from highway construction. We have worked with County Governments in some parts of the Nation as they developed county sediment control programs to control sediment in the urbanizing areas of their counties. We stand ready to provide the same cooperation with individual or groups of counties in the Lake Michigan basin should they desire to implement such a program.

In summary, I would again stress the seriousness of sediment as a pollutant. I would also stress the fact that we now have the technical know-how to control excessive sedimentation on nearly all land uses. Additional efforts and a willingness to carry out necessary conservation measures is needed by all land users to effectively control the sediment pollution problems in Lake Michigan and its tributary streams.

We in the U. S. Department of Agriculture and the Soil Conservation Service stand ready to participate in active programs to solve the problem.

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MR. STEIN: We will stand recessed for ten minutes.

(Recess.)

MR. STEIN: May we reconvene?

All the material that was presented by Mr. Poston will be entered into the record as if read, the material that he presented before the recess, as there is no objection.

Mr. Schneider.

We will now give the Conferees an opportunity to comment on the Federal Conclusions and Recommendations.

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DISCUSSION ON CONCLUSIONS AND RECOMMENDATIONS IN THE FWPCA REPORT

MR. STEIN: Who wants to start?

Or would you suggest that I go down these one at a time? I hope the people in the audience can find this. This may be a little better procedure; let me see if we might get uniformity.

I will start on page 63. Is that correct, Mr. Schneider?

MR POSTON: Sixty-five.

MR. SCHNEIDER: The conclusions start on 63 and the recommendations on 65.

MR. STEIN: Sixty-five, right. All right. I thought my reading glasses were working.

To save time I will not read these. If you want to follow the ball game, get one of these books out.

No. 1 conclusion. Any comment?

MR. MITCHELL: Mr. Chairman.

MR. STEIN: Yes.

MR. MITCHELL: Page 65 is the recommendations and you say No. 1 conclusion.

MR. STEIN: Yes. I am going to cover the conclusions first on page 63. No. 1.

Are you all set? Any comment or question?

(No response.)

MR. STEIN: If not, No. 2.

(No response.)

MR. STEIN: There is no comment?

By the way, if we pass one, we can go back. In other words, you are not foreclosed if I pass one.

No. 3.

MR. HOLMER: Mr. Chairman.

MR. STEIN: Yes.

MR. HOLMER: The next to last sentence of this conclusion is that feasible methods exist for bringing this problem under control. I presume that this does not mean that our present research projects at Green Bay and Milwaukee would be unproductive.

MR. SCHNEIDER: I wouldn't think so, no. We would still want to continue on with the research program.

MR. STEIN: Any other comment?

MR. HOLMER: Well, let me pursue this just a bit.

Would it be more appropriate to modify that or limit it to technical feasibility? We may be talking in some of these methods about rather expensive methods, and your feasibility in this sense is restricted to technical feasibility rather than a description of economic feasibility.

MR. SCHNEIDER: I think based on Dr. Weinberger's testimony, he feels that feasible methods do exist and we based our conclusions on the information that we had from Dr. Weinberger.

MR. HOLMER: Some of that information indicated certain removal capabilities for certain of the chemical precipitation processes were achieving 99 percent removal capability, for example. This, however, was in at least two instances, to our knowledge, in Wisconsin based on the use of filter samples. The data submitted by Dr. Weinberger were to the effect that we could hope for three-cent, four-cent treatment per thousand gallons. Michigan confirmed this yesterday, I recognize, at least in part, for the cost of chemicals. But we are talking here in a range of increased sewage treatment costs all told, including capital investment and disposal of sludge, et cetera. Are we not talking about an increase in total cost of sewage treatment in excess of 50 percent over current conventional methods?

MR. SCHNEIDER: Well, before hearing Dr. Weinberger I would probably have agreed with that, but the cost, as I recall, that he quoted included the capital investment.

MR. HOLMER: Yes. But what I am asking really is the comparison between the costs he cited, which are up, let's say, at 4 cents and did not include the sludge removal. Are the total costs not in excess of 50 percent of current secondary treatment?

MR. SCHNEIDER: Frankly, I wouldn't--

MR. HOLMER: I think we would want to pursue this further when the appropriate time comes. But I wanted to raise this question because it is a matter which we should understand before we proceed with concurrence on proposed recommendations.

MR. SCHNEIDER: Well, again my impression from Dr. Weinberger's presentation was that the costs he presented were the total costs for this additional removal; and I think when Mr. Pierce discussed their projects yesterday that, well, he said the cost was only for the chemical addition, this was based on incomplete mixing of the chemicals, there was no flocculation provided, and they were just introduced in a lift station, for example, where there wasn't adequate mixing. So there is a difference in the cost from what Dr. Weinberger was talking about and what Mr. Pierce was discussing. It is going to cost more, there is no doubt about it.

MR. WISNIEWSKI: Mr. Schneider, Weinberger's costs are based on plants with a 10 million gallon per day capacity. He says they can hit 5 cents per thousand gallons. This is what Weinberger said.

Now, how many plants do we have in this entire drainage basin which have capacities of 10 million to 20 million gallons per day? We have many little plants of 100,000 gallons capacity, 200,000, 500,000. Certainly these are not

MR. SCHNEIDER: Well, again my impression from Dr. Weinberger's presentation was that the costs he presented were the total costs for this additional removal; and I think when Mr. Pierce discussed their projects yesterday that, well, he said the cost was only for the chemical addition, this was based on incomplete mixing of the chemicals, there was no flocculation provided, and they were just introduced in a lift station, for example, where there wasn't adequate mixing. So there is a difference in the cost from what Dr. Weinberger was talking about and what Mr. Pierce was discussing. It is going to cost more, there is no doubt about it.

MR. WISNIEWSKI: Mr. Schneider, Weinberger's costs are based on plants with a 10 million gallon per day capacity. He says they can hit 5 cents per thousand gallons. This is what Weinberger said.

Now, how many plants do we have in this entire drainage basin which have capacities of 10 million to 20 million gallons per day? We have many little plants of 100,000 gallons capacity, 200,000, 500,000. Certainly these are not going to be able to do this at the 5 cent per thousand gallon rate. Theirs are going to be more nearly 10 cents to 15 cents per thousand gallons, and the practical test, Manitowoc, said 10-1/2 cents per thousand gallons.

MR. SCHNEIDER: Well, I think if you want an answer to that, we would have to go to the recommendations. The recommendations did not call for removal of phosphates in the smaller plants beyond the percentage indicated in Recommendation No. 2, which apparently can be achieved through modifications in existing secondary treatment facilities. In other words, there wasn't an intent here to get the maximum phosphate removal that Dr. Weinberger was talking about in all of the plants in the basin.

MR. WISNIEWSKI: That seems to be the inference, however, of the conclusion and the recommendation related to it.

MR. STEIN: Are you people agreed on what you mean? Because I think this can be adjusted.

MR. WISNIEWSKI: I think we can certainly agree that maybe Dr. Weinberger's processes will accomplish removal of 80 percent of the phosphate at a cost of 5 cents per thousand gallons in plants in the range of 10 million gallons to 20 million gallons per day, but these costs will not apply for the communities that have flows of 100,000 to 500,000 gallons per day. Their costs will be considerably higher than this unit figure. They just don't have this economy-sized package.

MR. SCHNEIDER: Well, again I think that Dr. Weinberger's cost figures were aimed toward removal beyond what you can expect in a secondary treatment plant with minor modifications. Now, hopefully you can achieve this 80 percent removal in smaller plants without the costs that he was talking about.

MR. WISNIEWSKI: The actual test runs upon which Dr. Weinberger based his conclusions indicated that on a full plant scale they were doing from 47 percent to 77 percent removal, on full-scale plants. The other higher figures were obtained on pilot scale and on lab scale sizes. So that when you get to actual full-scale you are not going to get anywhere near 80 percent removal, and the bigger the plant the less your chances of getting a high removal.

MR. KLASSEN: I have a question, Mr. Chairman.

MR. STEIN: Yes, Mr. Klassen.

MR. KLASSEN: Are you through, Mr. Holmer?

MR. HOLMER: Yes.

MR. KLASSEN: There is one point that I want to inject here. I first hope that we have feasible methods.

There is one phase of this that Dr. Weinberger did not cover; and I say this from our own personal experience because we are right in the process now of having a plant designed in the Chicago area for nutrient removal, phosphate removal, and this is the problem of adding to the effluent dissolved chemicals. In other words, you can add chemicals to remove the phosphates, but I believe--and I would like a comment from somebody who knows more about it than I do--that you also are at the same time increasing the dissolved chemicals in the effluent.

As I recall, in Michigan I think they referred to this where they were using some iron salts that they noted an increase in the iron content of their effluent. Does somebody want to comment on that?

MR. STEIN: I asked Dr. Weinberger about that myself, you know, after he gave his testimony. I don't want to necessarily give second-hand information, but his reply to me was that it would not be a significant problem.

MR. KLASSEN: It would not be?

MR. STEIN: That is what he said. This was the one thing that occurred to me, Mr. Klassen, and right after his testimony I questioned him on that very carefully, but I am not, of course, making the reply as having expert knowledge on this. I am just reporting my conversation with Dr. Weinberger.

MR. KLASSEN: The Conferee from Michigan, or Mr. Poston?

MR. POSTON: I might comment on that briefly, Clarence.

MR. KLASSEN: All right.

MR. POSTON: The use of iron as a coagulant, the iron is put in there in Michigan in the form as iron chloride, and it is the intent that the phosphate is picked up by the iron and settled out, and so that, at least theoretically, all of the iron would go to the bottom and be removed with the sludge and the phosphate.

The chloride radical would remain in the solution, and if excess of lime were used some of the additional dissolved solids would also come out similar to a water softening plant where excess lime treatment is used.

So depending upon the process, the method that is applied, it could actually reduce the dissolved solids.

MR. KLASSEN: But it could also increase it?

MR. POSTON: But it could also increase it.

MR. VOGT: I might comment about that, Clarence, a little bit. As you noted from our presentation yesterday, we did find some increase in the iron in the effluent, and of course the amount of iron will vary depending upon the limits that we go to or we attempt to reach in removal of the phosphates. If we want to remove higher quantities of phosphates and necessarily have to add additional iron, then we are going to have some additional iron in the effluent, and a lower phosphate residual we will have less iron in the effluent.

MR. KLASSEN: Thank you.

MR. VOGT: It seems to me, Mr. Chairman, that we are getting into some technical discussions here that might well involve some of our more technical colleagues to answer some of these questions.

MR. KLASSEN: I think, Mr. Chairman, too, like Mr. Vogt said, that this might be a reason for our maybe reconsidering something that is as definite as here in the recommendations, because we are right today faced with approving or disapproving methods for phosphate removal. I think that I am for coming out with something real definite, but I also hope that in so doing we are on a pretty firm technical basis so we won't be accused of spending money unnecessarily or making the city spend it. I know we all feel this way.

MR. STEIN: I think you are entirely right. The questioners will have the advantage of seeing where we need to produce the technical people to get up this information.

ROBERT J. SCHNEIDER

In Lake Michigan we are faced with a problem. If what was said here in the statements is true and Lake Michigan is eutrophying at a pretty rapid rate, I am not sure we have the time to make too many mistakes. We have to be pretty sure we are going to come up with the right kind of program. We may not have the second chance. And so we are going to have to look at these problems very, very carefully.

All right. Are there any other comments on that?

Yes.

MR. VOGT: Mr. Chairman, along this line, Conclusion No. 3, in the second line where it makes reference to other lakes within the basin, and then also going back to Item No. 2 where it says water uses of Lake Michigan and its tributaries, we have a question about the applicability of any conclusions or recommendations to tributaries as well as the lake.

In other words, for example, these water uses of Lake Michigan which are impaired, or which are alleged to be impaired, we pointed out in our report that swimming has not been impaired in Lake Michigan whatsoever.

Now, the question I raise is how do these conclusions and recommendations bear on the tributaries? It would seem that they might well be appropriate to direct discharges into the lake and in the tributaries possibly to those parameters where the discharge is to a tributary where the parameter is not changed in any way by the forces of nature before entering Lake Michigan and do not produce an injury.

MR. STEIN: Are there any other comments on that?

MR. SCHNEIDER: Well, my only comment is--

MR. VOGT: In other words, Bob, as you will recall, when your report was presented, Mr. Oeming raised the question about how might any depletion of oxygen at Lansing affect the oxygen content of Lake Michigan. And as I recall, your conclusion was that you didn't think that this would be affected.

MR. SCHNEIDER: I am sure in that case the stream probably recovers before it discharges to Lake Michigan, but--

MR. VOGT: This is the point that I

wanted to make, is it appropriate for all of these recommendations to be equally applicable to the tributaries as to Lake Michigan?

MR. SCHNEIDER: Well, I think that the biochemical oxygen demand that is exerted, say, at 50 miles upstream does have effects on Lake Michigan, and that the by-products of it, phosphates, for example, are still carried into the lake.

MR. VOGT: All right, we won't dispute, we won't have any question at all as to phosphates. So, therefore, I think we need to be more specific in our conclusions. And if you are referring specifically to phosphates, as far as Michigan is concerned, this is not an item of dispute.

MR. STEIN: Are there any further--

MR. SCHNEIDER: No, I don't think we are saying here that there is an oxygen deficiency in the lake because of a particular depletion of the oxygen sag 50 miles upstream, for example. But I think we are saying that the tributaries are polluted in regard to these parameters.

MR. VOGT: Which parameters again? See, in other words, you have to be specific again.

MR. SCHNEIDER: I think it goes down--

MR. VOGT: And as you mentioned, phosphates being one of them, we agree that phosphates discharged at Lansing ultimately end up into Lake Michigan. I think it is clear that some of the other parameters which might well affect a tributary a short distance downstream from a point of discharge would not adversely affect Lake Michigan.

MR. POSTON: I think, Mr. Chairman, that our major concern here is the nutrient problem in Lake Michigan, and that dissolved oxygen, while we still have concern for all waters of Michigan usable for desired water uses, our major concern here in interstate pollution is the nutrient problem.

MR. VOGT: I think that this coincides with our statement in the conclusions of our report, which I would just like to read here, that, "The Michigan agencies recognize the pollution problems on waters tributary to Lake Michigan and have in operation aggressive programs for their full and timely correction. The present deficiencies in waste treatment at inland locations do not contribute to pollutional conditions in Lake Michigan except as a residual phosphate loading carries on down to the lake."

So that in effect it appears that we were saying the same thing.

MR. STEIN: Are there any other comments?

MR. HOLMER: Well, certainly Wisconsin would reserve the right to question whether some of our phosphorus-laden waters which start on the upper Fox and run through Lake Winnebago could be demonstrated to reach Green Bay and hence Lake Michigan. But certainly we would not contest as a matter of principle the application of conclusions of this Conference to the tributary waters under terms that Mr. Vogt has been talking about. In other words, the applicability to the quality of Lake Michigan is the key criteria.

MR. STEIN: May I make a suggestion here? And this is one, as I see it, that may facilitate this.

A lot of the conclusions here may relate to tributary streams of shoreline areas. I think that the views of the States have been made clear on this.

Now, I think we can reserve that until we define this. We would like to have this statement just largely for clarification and better understanding of the comment. But we can continue this general comment all the time.

On this question of jurisdiction, obviously, in an interstate pollution problem there are certain aspects of the case which are the important ones. The other points may be intrastate operations now.

This is a question that the Conferees are going to have to resolve. As the Secretary pointed out to me before I left, after he looked at this report, he said that it looks as if what happens on these lakes is that we get severe situations around the end and sides and we begin to pick them to death and then we can't get at it at the middle sometimes before it is too late.

Now, the question here in these descriptive operations, I think, will be to determine, I would suggest, whether these statements are correct or clear. As to whether there is a jurisdictional matter for this Conference to consider, we can take up when we formalize these into conclusions and recommendations of the

Conferees to see what our jurisdiction is. But I think we can keep raising this jurisdictional question on every one of these. The point is well taken, but let's see if we can confine it to this go-around, because this is a point that can be repeated over and over again.

This is an essential point, I might add, that the Conferees will have to come to grips with when we promulgate our conclusions and recommendations.

No. 4.

(No response.)

MR. STEIN: No. 5.

MR. POOLE: Mr. Stein.

MR. STEIN: Yes.

MR. POOLE: I just want to reserve the opportunity to examine some of the background data on this business of sludgeworms all the way from Chicago to Muskegon, Michigan. I have seen a good many of the Indiana beaches to the east of Gary that I certainly wasn't aware of their being any sludgeworms there. I am just making that point.

MR. STEIN: Right.

Now again let me make it clear. We are just going through this right now in a preliminary fashion. You can come back to any point. Bypassing over any point, you haven't waived any right to discuss or any rights in any way. We are just trying to go through this as we went through the other reports for an attempt at clarification, to see how close we can get together. The way it looks to me, we are getting pretty, pretty close.

No. 5.

MR. SCHNEIDER: Mr. Chairman, I have a comment on the conclusion as it appears in the report. There is a typographical error. Benton Harbor should have been moved into the next--or down the line.

MR. STEIN: Where does it come?

MR. SCHNEIDER: Well, it says Michigan City and Benton Harbor, Indiana. That should have been down the line. It should have been Muskegon and Benton Harbor, Michigan.

MR. STEIN: O. K.

Any other comment?

(No response.)

MR. STEIN: If not, let's go to No. 6.

(No response.)

MR. STEIN: No. 7.

MR. HOLMER: Mr. Chairman.

MR. STEIN: Yes.

MR. HOLMER: The last sentence of Item 7 says, "A special evaluation of the combined impact of siting many reactors on the shores of the lake, in relation to retention and flushing characteristics and to accumulation of radionuclides in aquatic organisms, is desirable."

I assume that this is intended as a declaration of Federal responsibility?

MR. STEIN: Go ahead.

MR. POSTON: Mr. Chairman, I think this was intended that this be a joint responsibility here. It appears that many people have concern about this, and I know Senator Muskie has indicated he will hold hearings out in this area concerned with these particular problems. We have had a request from the Assistant Secretary that we develop plans for special studies and we have had some talks with some of the people concerned with these particular powerplants and I feel that the

States should be involved in this special study as well.

MR. HOLMER: We are certainly very interested and desirous of assuring ourselves that no harm can result from the proposed installations, but these are, after all, Federally-approved installations, and while we want to cooperate with you in the collection of data in order to protect our own interests, the leadership for such investigation certainly must be accepted as a Federal responsibility.

MR. STEIN: I think that point is well taken, Mr. Holmer. And as some of the people at the table know, that is probably--at least I spent a good deal of time in this battle on nuclear energy and radioactivity in water. And very often, because of the nature of the program, we have to do the testing and provide the incentive.

But in the cases that we have moved on this, I have always found that we have had unanimity with the State agencies concerned with water pollution control. And I might say that our hand in protecting these waters from radioactive contaminants has been materially strengthened by joining with the States, and I hope you will join with us in this activity, because some of these battles get pretty complex and pretty tough and we would like to have your aid.

For example, I think when we did this in the Colorado Basin States, we and the seven States there were unanimous on every point, and I think unless we stayed together we wouldn't have achieved the victory out there and the clean-up out there that we did. We need your help, we hope you work with us, but we recognize this as a responsibility and we won't let it go by the board.

MR. HOLMER: Thank you.

MR. VOGT: Mr. Chairman, even though these nuclear energy plants are licensed by AEC, we in Michigan have still felt that we had responsibility in connection with any waste discharges, and certainly we want to participate in any evaluation of this nature.

MR. SCHNEIDER: John, aren't you already sponsoring a study of one of the tributaries as an example of what the heat effect, at least, would be upon the lake?

I understood from Mr. Oeming in conversations with him that there is a study being conducted under sponsorship of the Public Utilities Commission in Michigan.

MR. VOGT: Offhand, I am not aware of this, Bob. The nuclear energy plants that we have now are right on the lake rather than tributary to a--

MR. SCHNEIDER: No, but I think this is one of the points that I made in my presentation, that the discharge from these nuclear plants is of the same magnitude as some of these tributary streams, and apparently there is one of your larger tributaries that have about the same temperature differential that could be expected from a nuclear powerplant. In other words, it was intended, as I understood, to study the--

Well, go ahead, Ralph.

MR. PURDY: This is Purdy from Michigan.

One of the companies' new proposed nuclear reactors as a part of their initial statement and proposed use and information to be furnished to the Water Resources Commission, has contracted for a study to be made of the effect of, say, the heated discharge of the Grand River. The Grand River runs at a higher temperature than Lake Michigan. It also has an average flow about equivalent to that of the new proposed reactor. And so study is being made on the effect of this heat and where it goes into Lake Michigan at the present time and this information will be presented to us in our evaluation of the problems that might be caused and the restrictions that might have to be placed upon the heat of discharge from this new reactor.

MR. SCHNEIDER: I think in addition to the temperature effects there are other effects that can be anticipated in terms of the growth of slime, and so forth, in the conduits or pipes, and whatever application of chemicals is used to control this may have an effect upon the water also, considering the large volumes of water that will be used.

MR. PURDY: This study will include the effects on the aquatic environment also.

MR. STEIN: If there are no further comments, may we go to 8?

(No response.)

MR. STEIN: 9?

(No response.)

MR. STEIN: 10?

(No response.)

MR. STEIN: 11?

MR. HOLMER: Mr. Chairman.

MR. STEIN: Yes.

MR. HOLMER: In this list of items which is recited up through 11, there is no mention of the potential increase in the salt content of the lake as a result of its use as a snow control measure. We recognize that there is apparently no adverse effect at this point, but I would hope that somewhere in this report, before it is concluded, that there would be some reference to a concern for this and advance protection against any danger.

MR. STEIN: Mr. Schneider, was that overlooked or could that be an addition that we could put in, a concern for the--

MR. SCHNEIDER: I think there were some studies made on it by our office and I think that we could have a concern here, yes.

MR. HOLMER: This is all that we can offer from Wisconsin. We have engaged in a pretty careful study of the problem because we use a lot of it, mountains of it. It undoubtedly finds its way into the streams and into the lakes and we are concerned. To this point the concern is not demonstrable to a degree that would warrant the abandonment of its use, but we are afraid of the kind of drift that brought us to where we are, and so we would want to express some concern about it.

MR. STEIN: I think that point is well taken and that is something that has to be guarded against in the lake.

How about No. 11?

(No response.)

MR. STEIN: 12?

(No response.)

MR. STEIN: 13?

(No response.)

MR. STEIN: That finishes the Conclusions. Now we will move on to the Recommendations.

MR. KLASSEN: Mr. Chairman, are you waiting for comments on 1?

MR. STEIN: Yes.

MR. KLASSEN: General comments on several of these, and I will refer specifically to their numbers. We feel these are too general and some rather vague, and specifically on Recommendation 1, and I will file these with you as a document for this report.

(Which said document submitted by Mr. Klassen is as follows:)

MEMORANDUM

SUBJECT: LAKE MICHIGAN 4 STATE CONFERENCE -
January 31, 1968
DATE: February 1, 1968
FROM: C. W. Klassen, Technical Secretary
Illinois Sanitary Water Board

We have had an opportunity to pre-review the general recommendations of the Federal Water Pollution Control Administration in connection with the Four State Conference on Lake Michigan pollution. We would like to offer the following comments numbered in accordance with the recommendations presented.

1. Reference is made "to the extent necessary". It appears that this statement should be more specific. Also reference is made to standards

However, no standards were recommended and in view of the usage of the word standards in the Water Pollution Control Act of 1965, we believe that this is a reference to water quality criteria.

5. The words "maximum treatment" is used. We believe this requires further definition as to what is meant by maximum treatment of all industrial waste.

8. The words "maximum practicable" are used. We believe this requires further definition as to what is meant by the terminology.

9. The word "maximum" is used. It appears that a more positive level of protection desired is necessary rather than just the terms maximum protection.

10. We do not understand the purpose or the value of maintaining accurate records of quantities of pesticides utilized on a county basis. Other than pure statistics, we do not understand the intent and purpose of this item.

11. The statement "initiation of corrective action where needed" appears to need

clarification. Particularly of the words where needed.

16. In connection with the reference to control over the discharge from watercraft, we would be interested in knowing the status of the proposed Federal regulations involving interstate vessels on the Great Lakes.

18. Reference is made to prohibiting discharge of oil. We are interested in knowing how the presence of oil, or absence of it, will be measured. What concentrations are indicated? Would this mean 15 mg/l, 10 mg/l or zero mg/l.

19. The statement "where necessary" appears to need clarification.

21. Reference is made to polluted dredgings. This needs definition and particularly the use of the word polluted or the meaning of the word pollution. Illinois recommends that there be no dredgings of any nature or any solid material deposited in the lake.

24. Where on Lake Michigan are hydroelectric plants located and specifically where are any which would influence water temperature in Lake Michigan.

Under specific recommendations reference is made to substantial reduction of nutrients. What is meant by this terminology and what level of measurable nutrient? The statement substantially eliminate pollution from combined sewers needs clarification as to what is meant by substantially.

It is recognized that most of these points will be discussed in connection with the preparation of final recommendations. However, we desire to point out the need for clarification at this time.

(Signed) Clarence W. Klassen
C. W. Klassen, Technical Secretary
Illinois Sanitary Water Board

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MR. KLASSEN: In reference to the words "to the extent necessary," it appears that this statement should be more specific.

Also reference is made to standards, that is the last word. However, there are no standards recommended in the report. Are we to assume, in view of the usage of this word "standards", that they will be the criteria that are referred to in those approved by the Secretary? Or will this Conference come out with standards to reiterate it?

MR. SCHNEIDER: No, it refers to the water quality standards approved by the Secretary.

MR. STEIN: This is a question of drafting. I don't know if you are going to feel any better about this, Mr. Klassen, but so far I have gone right down the line with you on your comments for the record. That is well taken. But I think what you have indicated would require a tightening up of these so we are specific and we have a blueprint to move on from here.

Do you want to confine yourself to one now or do you want to bring up the others?

MR. KLASSEN: No, as you come down to these. There are only four or five of them.

MR. STEIN: All right.

MR. VOGT: Mr. Chairman.

Also I have a question as to the definition of advanced waste treatment. I infer from other comments in the Recommendations that this is referring primarily to the removal of phosphates.

Is that correct, Bob?

MR. SCHNEIDER: Well, I think we are thinking in terms of additional removal. If you remove phosphates you will get additional removal of other constituents.

MR. VOGT: But back over here where you get into your specific recommendations, I infer from the language there that you are really primarily interested in the removal of phosphates when you refer to advanced waste treatment. I have a feeling that this needs to be clarified.

MR. STEIN: I think again that point to be well taken. Sometimes I am not sure that we are not hoist by our own petard when we talk about primary treatment. Maybe we are all right there. But then when we talk about secondary treatment, tertiary treatment, advanced waste treatment, and not being sure precisely what we mean or every State or every person having a slightly different idea, it may be wise when we are talking about this to try to be as specific as possible.

You know, we talked about secondary treatment in one State and then the State came out with a definition of secondary treatment which didn't coincide with our people, and I have been out there adjudicating the flap ever since. I think the more we talk in terms of percentages or items like phosphate removal or pounds per day and the more specific we can get, the better off we are going to be in carrying out these programs.

May we go to 2?

MR. POOLE: Mr. Chairman, on No. 2, I am generally in accord with the 90 percent BOD removal and the 80 percent phosphate removal, but I want to point out that if we are going back onto the watersheds we have a few small trickling filter plants in the State of Indiana that the 90 percent removal is going to be pretty tough on. We have indicated in our report to the Secretary that trickling filter plants had to do at least 80 percent removal and activated sludge plants 90 percent removal, and we would decide on the basis of the given situation which system was applicable.

MR. POSTON: Mr. Poole, I think we like to deal from a position of strength, and this is what we think will do a good job. And that is the figure.

MR. STEIN: I tell you, Mr. Poole's comment is not the first time I have heard a comment like that. We are going to have to meet that problem, obviously, with a practical program when we get down to really dealing with pollution abatement. I don't think any statements are going to make the problem go away.

I do think, Mr. Poole, that your statement is pertinent indeed. The problem here is in dealing with a tremendously able and conscientious administrator like Mr. Poole, when you talk about at least 90 percent, that is what it means, and when you have a little old plant where you may have a trickling filter and 80 percent, but it is not really affecting this, if they are in technical violation of this, you have a problem.

I think, Mr. Poole, your point is well taken, and I would hope that the Conferees come to grips with that realistically as early as possible, because if you don't do it now, when we get to working out the program we are sure going to meet it.

MR. VOGT: Mr. Chairman, I would just

like to support Blucher's comments in this respect. This is basically our position in Michigan too.

MR. STEIN: May we go to 3?

MR. POOLE: I have a comment on 3, Mr. Chairman.

MR. STEIN: Yes.

MR. POOLE: I have some reservations about flat recommendations for year-round chlorination in the St. Joe basin. We have said that Gary and Hammond and East Chicago or any other place that has a bearing on either a beach or a public water supply--well, no, on a public water supply should go to year-round chlorination. In the St. Joe basin we had said chlorination from April through October, and I believe Mr. Klassen yesterday or the day before raised the question about this chlorination.

MR. STEIN: Michigan has no problem with this, I take it.

MR. POOLE: No, I understand that.

MR. STEIN: Are there any other comments or questions?

Let's go to No. 4.

MR. HOLMER: Mr. Chairman.

MR. STEIN: Yes.

MR. HOLMER: I would assume that this sentence should read "Organic wastes and sanitary sewage discharged by industries receive the same degree of treatment as recommended for municipal wastes" rather than "the same treatment."

MR. STEIN: Yes. That is what is meant, isn't it?

MR. SCHNEIDER: Right. I think that that would make sense.

MR. KLASSEN: I just want to raise the point here, I don't believe that we should tie down industrial waste treatment, for example, to a 90 percent BOD removal. Wouldn't it be possible to--no, let me say, it is possible to have an industrial waste with a BOD, we'll say, of 2,000 so you have a 90 percent removal and you are still going to end up with a pretty strong effluent.

I think we ought to get something more specific than this to know what kind of a job is going to be done.

MR. STEIN: Possibly. Don't they say at least 90 percent? Ninety percent is the minimum.

MR. SCHNEIDER: Well, I can tell you what we intended. Number one, in talking in terms of advanced waste treatment, we expect that you can get better removal than 90 percent in that type of treatment, and in many industrial wastes I am sure you can get better than that.

MR. STEIN: Do you really mean what you just said, Bob?

MR. SCHNEIDER: What is that?

MR. STEIN: Do you really mean what you just said, that you intended that in No. 1 to be the answer to this? Because if you did, I think Mr. Klassen's point is well taken, that these sure have to be tightened up. I will give you my notion. In reading this No. 4, if I thought that to go above 90 percent or something in the municipal treatment I automatically had to refer back to No. 1 to get the answer, I guess I misunderstood. And I think we had better go through these with the notion of clarifying them.

MR. VOGT: Mr. Chairman, it seems to me that this discussion that is going on here emphasizes the problem or points up the problem that we get into when we just specify any degree of treatment. It seems to me what we are really interested in is to prevent injuries and to protect legitimate uses of these waters. And, therefore, it seems to me that we need to do whatever is necessary to protect the uses in that particular stretch of the stream or in Lake Michigan.

And one of the practices that we follow in our orders is not necessarily to specify a degree of treatment, but, rather, to impose a loading on a particular discharger, whether it be industry or whether it be a municipality. And in terms of poundage allocation. And in this way you are actually--then they do whatever treatment is necessary to get down to that load.

MR. STEIN: That is always preferable. I certainly agree with you on that, and we have worked with Michigan on this problem many, many times. I think, though, what Mr. Schneider was giving was the area that we would be going for in these conclusions. Again, if you are a State agency? I am in favor of coming up with the poundage of load rather than a degree because then you know where you are and the City and industry knows where they stand.

May we go on to 5?

MR. KLASSEN: On 5, Mr. Chairman, I have a comment and that is the words "maximum treatment." I think that this requires further definition as to what is meant by "maximum treatment." Is this maximum as technically possible or--I think I know what the implication is here as much as is necessary.

MR. STEIN: Yes.

MR. KLASSEN: But I do feel that maximum should be a little more definitive.

MR. STEIN: I think you are right, but, Clarence, I think what we are doing is hitting a variant on the same point. They will probably answer that this comes back to that advanced waste treatment in No. 1.

Now, I think we should flag all these things, but you know, this sometimes reminds me of when my younger girl went to elementary school and she took a math test, she would make a mistake and repeat that in every example and the grade would go down.

I think your point is well taken and it should be flagged. I think what they meant when they referred to this is that you apply that advanced waste treatment, No. 1, to all of these things to bring it up. I do agree with you that we need a sharpening up of these things, and wherever you make the point, it is well taken; we will have to work on that.

MR. KLASSEN: I think the same thing, Mr. Chairman, so I won't have to repeat myself, applies, the same point, the same argument, to No. 8; "maximum practicable," is another type of thing. It refers to a different area.

MR. STEIN: Right.

MR. KLASSEN: But when we have maximum, maximum practicable, is this economically practical or what?

MR. VOGT: Mr. Chairman.

In connection with the industrial waste discharged to municipal sewer systems where at all possible, I think this is basically sound. I am sure Bob had in mind that if the industrial wastes were not compatible to the biological process and would seriously interfere with the biological process at the municipal plant, then this would not be required.

MR. SCHNEIDER: Yes, that is right.

MR. POOLE: I just wanted to endorse what Mr. Vogt and Mr. Klassen said. I was going to raise the same question they did.

MR. HOLMER: Mr. Chairman.

MR. STEIN: Yes.

MR. HOLMER: I would like to say that I intended to raise the same questions that the preceding three Conferees raised.

(Laughter.)

MR. STEIN: And I am sure they didn't consult. These just come to mind. I think both those points are very well taken.

No. 6.

(No response.)

MR. STEIN: 7.

MR. KLASSEN: On 6.

MR. STEIN: Yes.

MR. KLASSEN: I think that really needs a little tightening up. I know this wasn't done by design, but when we say "Wastes from Federal activities"--this is a little vague--"be treated to degrees at least as good as that recommended for other sources," now, if this isn't a combination of vagaries, I have never read it. What other sources? A degree as good as, this doesn't mean-- I know what is going to be expected of the Great Lakes Naval Training Center at Fort Sheridan, but I think this really needs sharpening up in order to make the Federal agencies themselves look good. I am not here to--

MR. STEIN: I agree with you. I think I know what they mean.

MR. KLASSEN: I do too.

MR. STEIN: But we have to rewrite that.

7. Is there any comment on 7, combined sewers?

MR. POSTON: Well, I think I have had some question about combined sewers and elimination. I think here again we feel that we have a demonstration and research program on ways to treat the combined sewer overflows, such as Milwaukee and here in Chicago they have the deep tunnel plan, and in such cases where there are other provisions taken to handle this overflow problem, we do not intend that separation sewers be required.

MR. KLASSEN: Would you say that again, Mr. Poston?

MR. POSTON: We don't intend that sewers be separated--for example, in Milwaukee or Chicago they have a deep tunnel plan. They have a plan that they are experimenting with in Milwaukee, and if these prove satisfactory and will treat this storm overflow, we don't feel that it is necessary to separate the sewer for that particular area where there are other devices employed.

MR. KLASSEN: I also feel that this again is--this is a real important question in the Chicago area, like it is all over. Talking about combined sewers, I think that new combined sewers ought to be prohibited, not necessarily in newly-developed urban areas but in existing urban areas. According to this it might leave the impression, and I know that isn't what you want to leave, that new combined sewers could be built in existing urban areas. Here it says "be prohibited in all newly-developed urban areas." We have prohibited combined sewers in Illinois since 1929.

I think that needs sharpening up, Mr. Chairman.

MR. STEIN: I would agree with you, sir.

8.

MR. KLASSEN: Well, I have already commented on 8. I think when you talk about maximum practical amount, this again needs some little more definitive language. We are talking about tremendously large expenditures, and I don't like to leave it open to conjecture and whatnot on somebody else's part because we know that these are going to be laid under our eyes when they question some of these things and say, well, this is what the Conferees recommend. I know the importance of these. This is why we are a little particular on the language. These are going to be used by people and when they might question degrees of treatment in these things, they are going to say, well, this is what the Conferees agreed to, and I just want to make sure that the language in here is something that is not going to alter our getting this job done in a hurry.

MR. VOGT: Mr. Chairman, I presume No. 8 is referring to overflow regulating devices on existing combined sewers?

MR. SCHNEIDER: Yes.

MR. VOGT: Is that correct?

MR. SCHNEIDER: Yes.

MR. VOGT: O. K.

MR. STEIN: Maybe that should be made clear.

No. 9.

MR. HOLMER: Mr. Chairman, I think we owe to the agriculturists a little more specificity here as to the means to be used. We agree that improvement is desirable, but I think we need to tell them how.

MR. STEIN: Is there any comment on that? When I first saw this report, that was the first comment I made, I think. I agree. And I think that will have to be done.

MR. POSTON: I don't think we really know how all the pesticides can be handled. I think as a result of this meeting it is clear to me that we not only need an inventory to tell where these pesticides are put out and sampling needs to be done, but we need some licensing laws, probably, in the State or Federal level to control the application of these pesticides.

MR. KLASSEN: Being on the State level, I think I am glad you added that "or possibly Federal laws" to tell a farmer when and how he could apply fertilizer.

(Laughter.)

MR. POSTON: Well, I was thinking primarily of the contractors who would do this, maybe, with airplanes or do it on a large scale.

MR. KLASSEN: This is only about 15 percent of the application in Illinois, Mr. Poston. I am talking about the other 85 by individual farmers.

MR. STEIN: Yes. Both Mr. Holmer and Mr. Klassen as well as Mr. Poston have outlined the problem. I think if there is anything we can do on this--and there may be things we can do--we have to come up with a fairly specific program; because I don't know that No. 9 tells anyone to do anything or you have got any kind of program that you can move forward on unless we come up with something.

I recognize the limitations in working with the pesticide program, one for which we don't have standard techniques that we can put forward; and secondly, it is hard to tell a farmer what to do; and by the same token, when we deal with these pesticides or other poisons, remember it is just as hard to tell that housewife who is in an apartment on the 14th floor of one of your buildings what to put down the sink. And a Federal or State law doesn't necessarily handle this question.

This is a very difficult problem, and I think if we are going to make any impact on it we have to come up with some specific and meaningful discussions on the way to move.

MR. MITCHELL: Mr. Chairman.

MR. STEIN: Yes.

MR. MITCHELL: It seems to me that one item that has been left out or maybe overlooked here is what contribution is being made by runoff from our land in terms of a nutrient being sent to the lake. I don't know that this problem has ever been specifically looked at by any agency of the Federal Government, although there is a lot of work being done to control erosion through the small watershed program and upstream report station programs. It seems to me it might be worthy for us to give consideration to joining together some forces here to give a real serious look at this erosion problem.

MR. STEIN: I think, Mr. Mitchell, that point is well taken. If we are talking in terms of--these are the figures I have heard here--if we are talking in terms of two-thirds of phosphates coming from municipal and industrial sources and one-third coming possibly from land runoff, and we think phosphates are the critical element that will have to be controlled, if we go around and don't pay any attention at all to that one-third, maybe we haven't done our job.

MR. WISNIEWSKI: Mr. Chairman.

MR. STEIN: Yes.

MR. WISNIEWSKI: I would like to make a point of the fact thatagriculture is not the only source of pesticide contamination of surface waters and that we should give some consideration to including in our recommendations a reference to the use of pesticides for forest and non-forest and non-crop lands by the people in their households, by the resort owners that are spraying for mosquito control, and many of them are using the non-degradable pesticides.

We find in studies, for example, that some of our resort lakes which are far removed from agricultural operations do contain in the fish within the lakes substantially higher quantities of pesticides than some of the areas that are right in the agricultural area. This may just be coincidence, but we do find it.

MR. STEIN: I think that point is well taken.

You know, in the Federal establishment, the Forest Service is in the Department of Agriculture. I do think they consider them agricultural, although there may be some differences of opinion.

MR. KLASSEN: I think we have neglected the farmer pretty much, Mr. Chairman, and I think maybe, and I know from our own legislative experience they kind of back away as to how you can control, but we have got a gun control law now and they are going to control how much you can spend abroad. It seems that to control pesticide and fertilizer application by the farmer certainly isn't as complicated as either of those two. I think this is something that the Federal Government should address itself to as well as the States.

I know in our State the last two sessions of the legislature this came up and it was swept under the rug. They appointed a committee or a commission.

MR. STEIN: Clarence, we may be able to regulate or control how much you can spend abroad, but we will never be able to regulate how much a broad can spend.

(Laughter.)

MR. KLASSEN: I don't agree with you.

MR. STEIN: No. 10.

MR. HOLMER: Mr. Chairman.

MR. POOLE: Mr. Chairman, I personally think No. 10 needs to be firmed up considerably and be made more specific. It seems to me that if I gathered anything from this last six days it is that we have got a common nutrient problem in Lake Michigan and that we may be on the verge of a common pesticide problem which goes clear back to the watersheds and isn't confined solely to the borders of the lake.

I for one would favor that that

recommendation be changed and that it include that the States consider legislation to start the regulation of pesticides. We can at least license the commercial applicants, which admittedly don't handle all of the stuff, but we have got to start somewhere and it seems to me there is one place to start.

MR. KLASSEN: Yes, I agree with Mr. Poole. It is seldom we agree, but I agree with him on this.

(Applause.)

I think that what I said before, a recommendation coming from these Conferees would be real helpful in the legislatures of these four States because I know what we are up against.

MR. HOLMER: Mr. Chairman, I would certainly endorse what they have said. My concern with items 10 and 11 is a little different.

In both cases the reference is to the State water pollution control agency, and in many of the States this may be appropriate, but certainly it might be a Department of Agriculture in one case or a Department of Natural Resources. Certainly in our own State we might do better in 11, for example, by having our conservation agency, which is another division in our Department, have that responsibility. So I hope we won't specify in the recommendations.

MR. STEIN: I think that comment is very well taken.

Are there any other comments on 11?

MR. KLASSEN: On 10 or 11 I merely add to what has been said. We have tried to get data on the amount of pesticides and fertilizers used in at least two of our counties not too far from where we are now. If anybody has any idea how you can go about this--I asked one of the other speakers, an agricultural man--I have got two points on this, are we just going to collect this information, which is all right, we need it, but if anybody has got any ideas on this, I would sure like to know it because we have tried it and have not been too successful.

MR. STEIN: 12?

(No response.)

MR. STEIN: 13?

(No response.)

MR. STEIN: 14?

(No response.)

MR. STEIN: 15?

MR. HOLMER: Mr. Chairman.

MR. STEIN: Yes.

MR. HOLMER: Our law requires us to foster the creation of sanitary districts with one goal, being the elimination of septic tanks. However, we would prefer not to eliminate septic tanks until there is an appropriate treatment replacement.

(Laughter.)

Also we would have an objection to the proliferation of all inefficient treatment plants, not only the small ones. In other words, this is--

MR. STEIN: Yes.

MR. HOLMER: We agree that generally consolidation is a desirable proposition.

MR. STEIN: I think those points are well taken.

Are there any other comments?

MR. MITCHELL: I didn't think Holmer could talk so seriously about that situation.

(Laughter.)

MR. STEIN: 16.

MR. KLASSEN: 16, Mr. Chairman.

I agree basically with what is said here.

However, along with this I think deadlines ought to be--maybe I am allergic to deadlines--deadlines should be established on this when there will be these uniform regulations as now provided by the City of Chicago Code. That is one comment that I think we will have to address ourselves to.

The other, and this is more a point of information, knowing the status of any proposed Federal regulations involving interstate vessels on the Great Lakes. I must agree with some of the comments made by the small boat owners that there should be some direction toward regulating these large lake vessels and interstate traffic. This is a Federal responsibility. And just what is the status of any proposed Federal regulations on interstate vessels? Can somebody tell me?

MR. POSTON: Mr. Klassen, at your request we have had a copy made of S.2525, which is Senator Muskie's bill on the Federal Water Pollution Control Act to control pollution from vessels within the navigable waters of the United States. This bill I think has passed--or, no, has been introduced and this is as far as it has gotten at this time.

I will now pass this to you for your information.

(Which said S.2525 is as follows:)

90th CONGRESS
1st Session

S. 2525

IN THE SENATE OF THE UNITED STATES

October 11 (legislative day, October 10), 1967

Mr. Muskie introduced the following bill; which was read twice and referred to the Committee on Public Works

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A BILL

To amend the Federal Water Pollution Control Act, as amended, to control pollution from vessels within the navigable waters of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Federal Water Pollution Control Act (70 Stat. 498), as amended, is amended—

(a) by redesignating sections 11 and 12 as sections 13 and 14 and renumbering succeeding sections; and

(b) by inserting after section 10 two new sections to read as follows:

II

“CONTROL OF POLLUTION FROM VESSELS USING THE NAVIGABLE WATERS OF THE UNITED STATES

“SEC. 11. (a) The Secretary, after taking into consideration technological feasibility, economic costs, the types of vessels, their operating patterns, and such other factors as he deems appropriate, shall prescribe in the Federal Register—

“(1) Regulations establishing standards for the control of sewage discharges from any vessel or class of vessels into the navigable waters of the United States for the purpose of preventing the pollution of such waters. The Secretary shall prescribe standards that apply, to the extent feasible, uniformly to each class of vessels under similar circumstances. Such regulations shall prescribe reasonable schedules for compliance, after taking into consideration the cost of compliance. The schedules for compliance shall distinguish between new and existing vessels, and shall give special consideration to vessels conforming to any State requirement or recommended levels of control set forth in the Handbook on Sanitation and Vessel Construction, Public Health Service, 1965.

“(2) Regulations governing the discharge of ballast and bilge water into the navigable waters of the United States from vessels engaged in commercial activities.

"(3) Regulations governing the discharge from any vessel of litter, sludge, garbage, or other substances of any kind or description, other than oil or dredge spoil, which originates on board a vessel or which is transported thereon into the navigable waters of the United States. Where the Secretary of the Army acting through the Chief of Engineers determines, after the effective date of any regulations issued under this paragraph, that the discharge of such substances from a vessel may constitute a potential obstruction to navigation, a permit to discharge such substances shall be issued solely by the Secretary of the Army or his designee in accordance with existing authorities and consistent with such regulations.

"(b) Regulations to carry out the provisions of this section shall prohibit discharges in quantities, under conditions, and at times and locations deemed appropriate by the Secretary, after taking into consideration the deleterious effects of such discharges on the public health, recreation, and fish and wildlife.

"(c) Regulations to carry out the provisions of this section:

"(1) may exempt classes of vessels from all or part of a regulation for such periods of time and under such conditions as the Secretary deems appropriate.

"(2) shall apply to vessels owned and operated by the United States unless the Secretary of Defense finds that compliance would not be in the interest of national security.

"(d) Before any regulations under this section are issued, the Secretary shall consult with the Secretary of State; the Secretary of Health, Education, and Welfare; the Secretary of Transportation; the Secretary of Defense; the Secretary of Commerce; other interested Federal agencies; and the States and industries affected. The Secretary shall also correlate any regulations issued under this section with efforts to control or eliminate other sources of pollution under this Act and other provisions of law. After regulations are issued, the Secretary shall afford all interested persons and public and private agencies and organizations a reasonable opportunity to comment thereon before they become effective.

"(e) Any manufacturer of a device which is designed to control the discharge of sewage from vessels or classes of vessels in accordance with the standards prescribed under subsection (a) of this section may request the Secretary to issue a certificate of conformance for such device on such terms and conditions and for such period as the Secretary deems appropriate. The manufacturer shall perform such tests as the Secretary may require and make the results thereof available to the Secretary. The Secretary of the Department in which the Coast Guard is operating shall from a safety standpoint prescribe regulations relating to the design, construction, alteration, and repair of, and the materials used in, any such device. Whenever the Secretary of the Interior determines that the device will control the discharge of sewage from vessels or classes of vessels in accordance with such standards, and the Secretary of the Department in which the Coast Guard is operating determines that the device is satisfactory from a safety standpoint, the Secretary of the Interior shall issue the certificate. Any device manufactured under said certificate which is in all material respects the same as the certified device shall be deemed to be in conformity with such regulations. The manufacturer of a certified device shall maintain such records and provide such information and reports as the Secretary deems appropriate and shall permit any employee of the Secretary to have access to and copy such records during business hours. All information reported to, or otherwise obtained by, the Secretary or his representatives pursuant to this subsection which contains or relates to a trade secret or other matter referred to in section 1905 of title 18 of the United States Code shall be considered confidential for the purpose of that section, except that such information may be disclosed to other officers or employees concerned with carrying out this subsection. It shall be unlawful for the manufacturer of a certified device to sell a device pursuant to such certificate if the device is not in all material respects the same as the certified device or to violate the terms and conditions of such certificate.

"(f) After the effective date of any regulations issued hereunder, it shall be unlawful for any vessel to pollute the navigable waters of the United States or to make any discharge from any vessel into such waters, except in accordance with such regulations.

"(g) Any person who knowingly violates the provisions of this section or any regulations issued thereunder or the conditions of any certificate issued thereunder shall, upon conviction, be punished by a fine not exceeding $2,500 or by imprisonment not exceeding one year, or both.

"(h) Any vessel violating the provisions of this section or any regulations issued thereunder shall be liable for a penalty of not more than $10,000. Clearance of a vessel liable for this penalty from a port of the United States may be withheld until the penalty is paid or until a bond or other surety satisfactory to the Secretary is posted. The penalty shall constitute a lien on the vessel which may be recovered by action in rem in the district court of the United States for any district within which the vessel may be found. This penalty shall not apply to a vessel owned and operated by the United States, or a State, or, except where such vessel is engaged in commercial activities, a foreign nation, or to any vessel subject to the provisions of subsection (i) of this section.

"(i) In the case of any vessel which is required by the Federal Boating Act of 1958 (72 Stat. 1754), as amended (46 U.S.C. 527–527h), to have a number and which violates the provisions of this section or any regulations issued thereunder, such number may be suspended by the appropriate enforcement agency administering the 1958 Act in each State for such period of time as that agency deems reasonable, and the owner or operator of such vessel shall, in addition to any other penalty incurred under this section, be liable to a penalty of $100 and such vessel shall be held liable and may be proceeded against in the district court of the United States where such vessel is found.

"(j) Anyone authorized by the Secretary to enforce the provisions of this section may (1) board and inspect any vessel within the navigable waters of the United States, except a vessel owned and operated by the United States or a State, or, except where such vessel is engaged in commercial activities, a foreign nation, to insure compliance with the provisions of this section, (2) with or without a warrant arrest any person who violates the provisions of this section or any regulation issued thereunder in his presence or view, and (3) execute any warrant or other process issued by an officer or court of competent jurisdiction.

"(k) The provisions of this section shall be enforced by employees of the Secretary of the Interior and by personnel of the Secretary of the Department in which the Coast Guard is operating, and the Secretary may utilize by agreement with or without reimbursement law enforcement officers or other personnel and facilities or other Federal agencies to carry out the provisions of this section, including the enforcement thereof. Law enforcement officers of any State enforcing a numbering system approved under the Federal Boating Act of 1958, as amended, shall also enforce the provisions of this section which are applicable to vessels covered by that Act. The Secretary is also encouraged to enter into agreements or other arrangements with any State in carrying out the provisions of this section, including the enforcement thereof.

"(l) As used in this section—

"(1) the term 'person' includes an individual, company, partnership, corporation, or association who is the owner, charterer, operator, master, officer, or employee of a vessel, and any individual on board such vessel, but does not include a person on board a vessel owned or operated by the United States or a State, or, except where such vessel is engaged in commercial activities, a foreign nation.

"(2) the term 'United States' includes the Commonwealth of Puerto Rico, Guam, American Samoa, and the Virgin Islands.

"(3) the term 'discharge' includes spilling, leaking, dumping, pumping, pouring, emitting, emptying, throwing, or depositing.

"(4) the term 'sewage' includes wastes from sanitary facilities on board vessels, such as toilets, wash basins, and laundries, and other contaminated waters.

"(5) the term 'manufacturer' means any individual, corporation, partnership, or association engaged in the manufacturing or assembling of a device to control the discharge of sewage from vessels, or in the importation of such device for resale, or who acts for or is under the control of any such individual or organization in connection with the distribution of such device, but shall not include any dealer of such device.

"(m) In the case of Guam actions arising under this section shall be brought in the district court of Guam, and in the case of the Virgin Islands such actions shall be brought in the district court of the Virgin Islands. In the case of American Samoa such actions shall be brought in the district court of the United States for the district of Hawaii and such court shall have jurisdiction of such actions.

"CONTROL OF POLLUTION FROM VESSELS WITHIN A ZONE OF THE HIGH SEAS CONTIGUOUS TO THE TERRITORIAL SEA OF THE UNITED STATES

"SEC. 12. (a) After the effective date of any regulations prescribed under this section, it shall be unlawful to discharge from any vessel sewage, ballast and bilge water, sludge, garbage, or other substances of any kind or description into the waters of the Contiguous Zone established under Article 24 of the Convention on the Territorial Sea and the Contiguous Zone which may pollute or contribute to the pollution of the waters of the territory or the territorial sea of the United States, except in case of an emergency imperiling life or property, or unavoidable collision, stranding, or accident, or except under regulations prescribed by the Secretary.

"(b) The Secretary shall prescribe regulations governing the discharge from any vessel of sewage, ballast and bilge water, sludge, garbage, or other substances of any kind or description, other than dredge spoil, which originate on board such vessel or which are transported thereon into the waters of said contiguous zone in such quantities and under such conditions and at such times and places as, in his judgment after consultation with other interested Federal agencies, will not be deleterious to health or marine life or dangerous to persons or property within the territory or the territorial sea of the United States. Where the Secretary of the Army acting through the Chief of Engineers determines, after the effective date of any regulations issued under this paragraph, that the discharge of such substances from a vessel may constitute a potential obstruction to navigation, a permit to discharge such substances shall be issued solely by the Secretary of the Army or his designee in accordance with existing authorities and consistent with such regulations.

"(c) The penalties prescribed by section 11 of this Act for violations of that section or regulations issued thereunder shall apply to violations of this section or regulations issued thereunder. The provisions of said section 11 with respect to enforcement, jurisdiction, and definitions shall be applicable to this section.

"(d) Regulations prescribed pursuant to this section shall apply to vessels owned and operated by the United States unless the Secretary of Defense finds that compliance would not be in the interest of national security."

90th CONGRESS
1st Session

S. 2525

A BILL

To amend the Federal Water Pollution Control Act, as amended, to control pollution from vessels within the navigable waters of the United States.

By Mr. Muskie

October 11 (legislative day, October 10), 1967
Read twice and referred to the Committee on Public Works

MR. KLASSEN: I just wondered about the date of introduction, this year?

MR. POSTON: October 10, 1967.

MR. POOLE: Mr. Chairman.

MR. STEIN: Yes.

MR. POOLE: I am aware that Federal Conferees can't agree to recommendations that involve Federal legislation, but as far as the State of Indiana is concerned we see no reason why the State Conferees can't include a recommendation when we come out of this Conference that there be Federal regulations to regulate and control commercial vessels.

MR. STEIN: Yes. That procedure has been adopted in Conferences before. You can be sure the Chairman won't stand in your way.

MR. MITCHELL: Mr. Chairman, I didn't quite understand Mr. Klassen's comment about putting deadlines on when laws should be enacted. I had difficulty with our legislature telling them they had certain deadlines. Did you mean a deadline before the Federal Government would enact the act?

MR. KLASSEN: No. No, on each State

regulation. Chicago has their enforcement date, I believe May 1st of this year. As has been appropriately pointed out, this is a start, it is a pattern. Do the other States:

1. Do the other States need State legislation for their water pollution control agencies to pass these regulations?

2. Can the State water pollution agency pass the regulations?

If so, this ought to be uniformly done so that the same applies in all four States, whatever this date might be.

MR. MITCHELL: Are you suggesting that maybe the four States get together and see if they can agree on a uniform regulation and then go back to their individual States and try to get it enacted?

MR. KLASSEN: Yes.

MR. MITCHELL: I think that is a good suggestion.

MR. STEIN: 17.

MR. VOGT: I have a question here, Mr. Chairman. Perhaps Mr. Klassen can answer this.

Does Chicago require facilities for

dewatering holding tanks, Clarence?

MR. KLASSEN: I think that there either are or will be facilities in Chicago for dewatering these holding tanks. And just as kind of a policy on this thing, we feel that regulations should assure that no sewage shall be disposed of in any manner as to reach the waters of Lake Michigan except through sewage treatment facilities which have been approved by the appropriate State agency. And this means so far as Chicago is concerned that it would be pumped out of these tanks into a sewer that is tributary to the treatment facilities in Chicago. This would apply also to the other cities.

I believe that these facilities are being provided.

MR. VOGT: Currently the State of Illinois doesn't have a requirement for this, is that correct?

MR. KLASSEN: Not Statewide at the present time. As a matter of fact, we are--I was going to mention this later--as of yesterday calling a special water board meeting the 19th to review the recommendations from this Conference to see what action that we have to take in order to be in complete conformance with these. We do have a regulation already in existence on all Federal-State impoundments. But we have stated this, that we subscribe to the Chicago ordinance approach that there be holding tanks and no discharge from any facilities aboard a watercraft until and unless this has been approved by the particular State agency.

And while I am on that, I don't want to open up this whole question again of yesterday, but reference was made to the National Sanitation Foundation and the regulations that are going to be adopted. These have not been adopted, in spite of what one of the men has said. I know this because I am a voting member of the committee that adopts these. I have voted against adopting these. They are not regulations for States to adopt. They are regulations, I think as possibly Mr. Poole mentioned, for testing. I don't think we ought to let ourselves be confused by statements that we should follow the National Sanitation Foundation standards that are on the verge of being approved.

The National Sanitation Foundation is

doing a tremendous job. We depend on them, but they have no standards at the present time that have been approved, and I want this to stand in the record.

MR. STEIN: 18.

MR. POOLE: I find a little difficulty with the last two words, "stopped entirely."

MR. STEIN: Oh, this is that zero tolerance. We have dealt with the same problem in the southern end of Lake Michigan. We said "no visible oil." I think we will meet that. This is not a new one and your point is well taken.

No. 19.

(No response.)

MR. STEIN: No. 20.

(No response.)

MR. STEIN: No. 21.

MR. HOLMER: This is not entirely in accord with the report of the Corps of Engineers, as I heard it earlier in this Conference.

MR. STEIN: Yes, I think you are right. This raises some questions: What do you mean by polluted dredgings? Do you put any dredgings?

I think the Conferees are going to have to meet both those questions.

MR. HOLMER: Right.

MR. STEIN: Whether any dredgings at all are put into the lake; if so, under what circumstances and when. I think these have to be met before we can draw up a tight proposal on dredgings, and I hope we will all be able to work very closely with the Corps of Engineers to try to get something that we can all live with.

You know, I think again we have a very special case here with the operating agency. It is very fine for the States and the Federal Government to come up with one, or, rather, the Department of the Interior, but we have to recognize that the Corps is going to have to operate with this. I would hope that a reasonable procedure could be worked out that the Corps could live with in the same manner as we try to work out a reasonable procedure with you where your cities and industries come into it.

MR. KLASSEN: Would this involve a new agreement between the Department of the Interior and the Secretary of the Army?

MR. STEIN: I don't know.

MR. KLASSEN: They have an existing agreement that was, I think, signed in July of last year that one of the Corps of Engineer's speakers referred to, but in reading this agreement the final word isn't with the Federal Water Pollution Control Agency, unfortunately, it is with the Corps of Engineers. And the way the agreement now stands, the Corps can decide if it is to dispose of material.

I am just wondering, in view of your statement, if this will take a new agreement between the Secretary of the Interior and the Army?

MR. STEIN: Well, I am not sure what it will take. But in this case if we can work out a program that the States think is acceptable, that we think is acceptable and the Corps thinks is acceptable, I am sure, whether we have to take State, Federal or any other action, we are going to take whatever action is necessary to put that program into effect.

22.

MR. HOLMER: Mr. Chairman, I have a

couple of questions here.

I couldn't tell from the last line on page 66 requesting the reports to be submitted to the appropriate agencies for review if this included the Federal agencies or if we were just referring to State agencies.

MR. SCHNEIDER: No, we were referring to State agencies and I changed that in my statement when I read them.

MR. HOLMER: Now, with respect to the substance of this recommendation. We have upgraded our inspections from an annual schedule to a semi-annual schedule. Now it is suggested that we go to a quarterly basis. Certainly we want to improve our performance as rapidly as we can.

Is this recommendation justified in terms of specific benefits that have been demonstrated in any way that the increased frequency is necessary in addition to the monthly reports? And furthermore, I think we might also have to reckon with the definition of what constitutes an inspection. You can drive by some plants and call it an inspection, and I would suspect that we want to define what we expect to find with an inspection.

But more importantly, or the toughest question I had was, how do I meet my joint finance committee and explain why we have got to increase our budget in order to make quarterly rather than semiannual inspection?

MR. SCHNEIDER: Well, I think Michigan is already inspecting on a quarterly basis, and maybe Mr. Vogt could tell you the results of his program.

MR. HOLMER: All right.

MR. VOGT: I think I will have to correct that a little bit, Bob. This was our goal to on an average get into plants quarterly. We are not reaching that at the present time. And also we set a goal as an average. In other words, we don't mean that we have to get into every plant on a quarterly basis. And I think this is common knowledge amongst my counterparts here from the States--that they find, as do we, that in some instances it is more important to get into some plants more frequently than this. In other cases, once or twice a year would be very adequate.

So I was going to comment about this

recommendation along this line where it says "conduct inspections of all waste treatment plants at least quarterly." I think this would be a goal which we could not support and it is going beyond what we really need to do.

MR. STEIN: I think that these points again are well taken. We have to work within the resources of the State agencies and come up with a realistic program. It is also my notion that when you come up with a program that isn't met you are in worse shape than coming up with no program at all, because then you get built-in neglect and violations right in your operation. I think we will have to look at this very carefully.

23. What does that mean, that we are going to come up with improvements? In other words, I wouldn't know how to follow that up. Don't you think we can get some people to come up with something specific on that?

MR. SCHNEIDER: I think we can. We can get together with our technical program people who are--

MR. STEIN: I think that is a job.

In a good many of the things, Bob, as

far as I see--we are coming to the end of this--a lot of the judgments here are semantic judgments. The points that you raise are very, very good ones. However, I think if the Conferees are going to set something like this up--I am not suggesting that we necessarily do this--a meaningful suggestion is that we give this to a technical group with representatives from each State and the Federal Government. In three to six months or something they can come up with a specific program for improving the monitoring and programs geared to changes in water quality. Then we will go over this and see what we can do to put it into effect. Otherwise I am not sure we are on our way.

MR. SCHNEIDER: Well, I think this can be handled through our ongoing program.

MR. STEIN: This may be. But then again we have to give someone a specific charge to do the job.

MR. SCHNEIDER: I agree.

MR. STEIN: All right. 24.

MR. HOLMER: Mr. Chairman, in our judgment this is not a possibility, although I suspect there is a substance to this recommendation which deserves our attention. It seems quite obvious to us that you cannot regulate streamflow so as to assure the availability of optimum streamflow for all legitimate uses concurrently. And while I am sure the intent is to assure that there is optimum--an effort to optimize the benefits from regulations of the flow, I think it needs to be restated, Bob, in some way that doesn't have the conflict between the desire for flood storage as opposed to the need for regularity of hydroelectric flow as opposed to the need for seasonal diversion for irrigation and the need for regularity of other kinds of flows, and so on.

I think this as stated is impossible of attaining.

MR. STEIN: Again that point is well taken.

Do you have any comment on that?

MR. SCHNEIDER: Well, we have had complaints in connection with the relicensing program.

MR. STEIN: Yes. But here is the issue. I think Mr. Holmer has this, and I face this all the time.

If you want to regulate a plant to insure the availability of optimum streamflow and you go to a power company, the fellow brings you into his office. Right there framed is a license from another Federal agency, the Federal Power Commission, to do what he is doing, and he says, "Aren't I operating legally and what does this mean?" And of course he is.

The notion that anyone in a State or a Federal water pollution control agency can overturn an existing license for a man who is engaged in a legitimate business is something that you might desire, but you can't do.

Now, in the licensing procedures, the Federal Power Commission is now very interested in what we are doing in making provisions for water flow. But I think Mr. Holmer's statement is well taken. Where someone has a license from the Federal Power Commission, that license is going to be obtained and the best we can do is try to get voluntary compliance or make representations when the license comes up for renewal.

Is this a fair statement?

MR. HOLMER: I think I have another

element of this. One of the purposes of this regulation, I suspect, is to have low flow augmentation to tend to insure the quality of the water. And if this is a part of it this is going to conflict with certain other uses such as flood prevention, for example, quite apart from the licensing, although the licensing is another aspect of this and a good illustration.

MR. STEIN: I think you are right. But doesn't he mean insure the availability of optimum streamflow for all legitimate uses? I think flood control is the kind of legitimate use you would have. Obviously water quality or the use of extra water for water quality has to compete with other water uses. This is just a fact of life and if the Conferees ignore this you are going to find yourselves up against something that just won't go away.

No. 25.

MR. HOLMER: I hesitate to come on again on this one, but let me stress what I tried to say this morning, namely that I think we need to be very careful in connection with the review of this recommendation that we do at least three things:

First, to review these recommendations very carefully to be sure that they are reasonably inclusive of the principal areas in which research is needed so that we do cover the waterfront.

Second, that we establish some set of priorities with relation to them as to which seem to us to be in most immediate need of attention.

And third, that we establish an assignment of responsibility and a timetable to the jurisdiction agency or industry whom we expect to undertake the activity.

MR. STEIN: Right. I think you have a point. Again we have this question of my making a list whether you are going to be inclusive or exclusive. I think we have this danger and the priority system may be the one that works.

But, you know, if you come up with a tremendous list of projects, the chances of your getting any begin to diminish as your list grows.

Conferees might want to determine whether they just want to have this--I have no conclusion on this--just want to have an exhaustive list, or they may want to pick three or four or five in order of priority that we hope to get moving in the near future and give the others honorable mention somewhere else. No matter where you put something on the list, you are going to have people with a special interest in that phase of it who are going to start pushing, and this makes it more difficult to get your other projects going.

This is something the Conferees really should think of very carefully.

MR. HOLMER: I agree to the idea of a short list, because I think your point is quite relevant. All I am asking is that we be sure that in our own judgment we have evaluated a sufficiently long list that our short list is the high priority one.

MR. STEIN: Yes, I would agree with that.

I am not going to ask for comments on the specific cities because that would take a long time and, as indicated, some of this material has to be updated. But if anyone wants to comment now, we are not asking for this, that in general the municipalities provide secondary biological treatment or its equivalent and treatment for phosphate removal by 1972.

MR. MITCHELL: Mr. Chairman.

MR. STEIN: Yes.

MR. MITCHELL: Are you now moving to 26, the recommendations?

MR. STEIN: Yes, specific recommendations, just the 1, 2, 3.

MR. SCHNEIDER: Mr. Chairman, he is referring, I think, to the numbered recommendations in the statement, I think you have a copy there. No. 26, that the--

MR. POSTON: Read it.

MR. MITCHELL: There were two recommendations that were added the other day, 26 and 27.

MR. POSTON: Can you read them?

MR. SCHNEIDER: No. 26, "The treatment required by the above recommendations shall be provided in facilities placed in operation by no later than July 1972, unless the State water pollution control agencies require a lesser amount of time."

And then No. 27, "The Conferees reconvene at least annually to assess progress."

MR. KLASSEN: Mr. Chairman, have you

taken the necessary action that these new recommendations will replace the ones in the report?

MR. STEIN: No, I think the Conferees are going to have to do this. It is your report.

MR. KLASSEN: It is your report.

MR. STEIN: I don't quite understand this, and I have a clarification question first.

You mean your recommendation is to handle the combined sewer problem by '72?

MR. POSTON: It says by '77.

MR. STEIN: Where? Not in the new one. Where? You have got--

MR. SCHNEIDER: Under the Specific Recommendations it called for handling the combined sewer problem by 1977.

MR. STEIN: Right. Now, as I understand your proposal, again we have to do this, that the kind of treatment we are going to have for municipalities and industries, including phosphate or other appropriate nutrient removal, will be completed in all cases by not later than '72, right?

MR. SCHNEIDER: That is right.

MR. STEIN: And the combined sewer

problem would be the work would be completed by '77.

MR. SCHNEIDER: That is right.

MR. STEIN: We also have a problem, as you know, the question of whether the four-State Conference is going to subsume the two-State Conference. We do have time schedules set up for the Indiana and Illinois industries and this has to be met too.

But I would suggest we confine ourselves to the '72 and '77 dates first. I am not sure that either one of those dates really, unless there is a generalized comment, concern Indiana or Illinois because you are well within those now except for the phosphates.

MR. MITCHELL: I would like to make a comment, Mr. Chairman. And so that it won't be misunderstood, I have taken the opportunity to write it and I would like to read it and it is in regard to the '72 deadline and in regard then to the nutrient removal, if I may read it.

MR. STEIN: Surely.

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STATEMENT BY
JOHN E. MITCHELL, CO-CONFEREE
DIRECTOR OF DEPARTMENT OF NATURAL RESOURCES
STATE OF INDIANA

MR. MITCHELL: This four-State Enforcement Conference on the pollution of Lake Michigan has spent six long days in listening to a tremendous amount of information, statistics, and recommendations. Much of the testimony was being made public for the first time and will contribute to the successfulness of the Conference.

All of us came to this Enforcement Conference knowing that Lake Michigan is a sick lake. We did not know how sick. As a result of the six days of work we have studied the symptoms, with the aid of such experts as Dr. A. F. Bartsch, Dr. Donald Baumgartner, and Dr. Weinberger, and we can say the patient, Lake Michigan, is not only sick but seriously ill.

We needed to know more about our patient and we needed to know how to determine the causes of the sickness. As a result of this Conference

JOHN E. MITCHELL

we have been told that nutrient pollution is the number one pollution problem and the number one cause for the increase of eutrophication or aging process of the lake.

The most important knowledge that we have gained as a result of this Conference is the knowledge as to how to cure the illness. Many of us came to the Conference with adequate knowledge of how to reduce organic, bacterial, harmful chemical, and thermal pollution. But we did not have adequate knowledge as to how to control the nutrient pollution. Today we have a greater amount of information and the future looks much brighter as a result of this Conference.

We were told that municipalities were the greatest contributors of the nutrients and it now appears that a high priority should be given to the removal of the nutrients at our municipal sewage treatment facilities.

This Conference has brought information to our attention that indicates we must move rapidly to cure this disease of our sick lake. Deadlines must be established for adequate control of nutrient pollution.

We have had many speakers from the national, State, and local governments that have indicated their deep concern in saving Lake Michigan. Everyone from all levels of Government have pledged to join efforts to make sure we get the job done.

But all of this knowledge, all of this concern, and all of this agreement will be for naught unless adequate finances are made available by all levels of Government.

I do not believe we can avoid giving consideration to the financial situation that exists. In a general way, we now know the amount of the sickness, we now know how to diagnose the sickness, and we now know how to cure the sickness. No longer will we be limited by a lack of concern or by a lack of knowledge. The only limitation we face is a possible lack of adequate finances to do the job.

It seems to me all levels of Government must contribute their fair share to "save our lake." As Conferees and as representatives of the Federal Government and the Four States and their Governors, we cannot be satisfied with our efforts if we only describe the cure and set the deadlines and expect the municipalities to be the ones to pay the bill.

If we are to be fully realistic in our recommendations to Secretary of the Interior Udall, it is my belief that we should recommend that all timetables for municipalities in regards to additional treatment facilities for nutrient removal must be tied to the availabilities of State and Federal funds.

If we are going to give high priority to the saving of the lake, then we must also give high priority for adequate financing. It is only reasonable that deadlines be coordinated with availability of funds from the governments that are establishing the deadlines in the first place.

The report of this Conference must clearly point out to the citizens of our four States and the citizens of the whole United States that know-how is available to save Lake Michigan and that everyone must share in the responsibility to provide the funds needed to do the job.

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MR. STEIN: Thank you, Mr. Mitchell, for a very clear and concise statement of the problem.

Does anyone have any other comments on this? Because, as you know, the deadline question is a very, very serious one and the one we are going to come up with.

MR. HOLMER: Yes, Mr. Chairman.

MR. STEIN: Yes, sir.

MR. HOLMER: One minor quibble and then a more important subject.

We have one project at Green Bay which is already under way which looks to a September 30, 1972, date for the earliest possible completion. This was another one of those specifics we ought to direct our attention to.

But the question Mr. Mitchell raised is a much more fundamental one and it is one that perplexes me just a bit. We have been told that the reason for the deferral of full Federal appropriations of the funds authorized for these works is the fact that we are engaged in a costly war and that we should, therefore, resist the temptation to engage in extensive public works.

We agree with the urgency of this program and the desirability of an early deadline, whether it be July '72 or some other, for the first deadline dates, and Wisconsin, I can assure you, will cooperate fully with the other States in this region in accomplishing that goal.

It will, however, if we are to achieve this goal, require a substantial expenditure of public funds for public works, and if these are not forthcoming from the Federal Government they will necessarily have to come from State and local Governments.

I am wondering about the consistency of the Federal position if it is to produce a report which requires such early action in the face of an adopted policy of the national Government, and it leaves me in a grave quandary, as I am sure it does you.

MR. STEIN: Are there any further comments or questions?

MR. KLASSEN: Just on that, I am not necessarily one to defend the Federal Water Pollution Control Agency, but I would express myself on this.

It is your job to clean up the waters of this country, but not your job to provide the money, and I don't think we ought to mix the two.

If the Federal Government can't give us the funds, then the local people ought to pay for it. And Illinois hasn't geared its program to a program of Federal control, because this gets to be a real elusive thing. I must disagree, I don't think just because the Federal Government has presented a report here that the same agency that presents this has got the responsibility to give us the money.

One other question while I have got the microphone, Mr. Chairman. I want to ask you as Chairman and as a Conferee, we have, since it has been referred to, this Federal Water Pollution Control report with recommendations. We also have, and I am reading, a statement by Mr. Schneider representing the Federal Water Pollution Control Admin. that has different recommendations in it. Basically they are essentially the same, but there are changes.

And I am asking you which are to be considered the official recommendations from the Federal Water Pollution Control Agency, the ones in the book or the ones that Mr. Schneider presented? And if it is the latter, have you taken action to make such a statement for the record?

MR. STEIN: Let me indicate this:

One, what you have from us--and I would like to raise this question with you and canvass the Conferees--what you have from us is an investigator's report. We are sitting here with you as Conferees to try to work out a joint position if we can on conclusions and recommendations. We have recommendations not only from our investigating team, as delivered by Mr. Schneider, we also have had suggestions and recommendations from the four States, all of them pertinent. And we have also listened to testimony, as Mr. Mitchell has pointed out, for six days.

I think in effect what the Conferees have now is a blank sheet of paper where they can write their own recommendations and conclusions and see if we can come to an agreement on them. None of these reports or none of these ideas have any more status than the others or than those of any of the people in the audience who have participated, as far as I am concerned.

The question that I would like to ask you, Mr. Klassen, in view of the complexity of this, do you think that we can come to these conclusions now or we may need some more time to reconvene?

MR. KLASSEN: No. This is my reason, again, for asking this question, because when I go back to my Board to consider these, I want to know which--they are going to ask which are the Federal recommendations. I will answer the other question in just a moment.

As I interpret your answer, we have two sets of Federal recommendations, these from the Federal Water Pollution Control Agency and these from Mr. Schneider.

MR. STEIN: No, no, no. There are none from the Federal Water Pollution Control Administration. You have conclusions and recommendations, at the most, from our investigating team.

Mr. Poston.

MR. POSTON: I think what was done here, Clarence, was the report was developed and instead of presenting the whole report to us it was briefed down. We included statements by Dr. Bartsch, Dr. Baumgartner and Dr. Weinberger to clarify, and this report was sent out prepared prior to this Conference to give technical information as we saw it on this basin ahead of time. The fact that there have been some changes in the recommendations I think was done by Mr. Schneider in order to make them clear.

MR. KLASSEN: I think Mr. Schneider's statement has improved on the report. Really. This is why I am wondering. I guess I won't get the answer.

MR. SCHNEIDER: I think the only--

MR. KLASSEN: I will read both of them, then, and--

MR. STEIN: Let's see if we can get this clarified.

I do think that a good many of the criticisms of the conclusions and recommendations in the report, and they were well taken, largely related to lack of clarity, semantics, and so forth. I think we had a notion of what was meant, but I do agree with the Conferees that if we are going to come up with a meaningful program we have to have tightly-knit conclusions and recommendations.

I also do think that when this report was put out, the Conferees alone, and this may include us and others, may have had the same notion and may have formally or informally conveyed their feelings to Mr. Schneider, and he did, as you pointed out, come up with a clarification.

We recognize two things. We do have a substantial job of redrafting to do in the kind of stuff that will be meaningful, and I think the bulk of the comments were directed to that. We also have some very hard substantive problems to meet.

Now, I am asking--I will again start my question--Mr. Klassen, do you think we can meet this today or you will need some time to consider it?

MR. KLASSEN: Definitely not here today. I think that anything as important as a program such as this, we had better make awfully sure that what we come up with and all agree to or disagree to is something of which we have complete knowledge. I believe that the Conferees--I am just speaking for myself--need some time to digest particularly this last statement and some of these other things before we can properly evaluate and make a decision on what your redraft is going to do. I want to see your redraft of these recommendations again before I will comment on it. Obviously you are not going to do that today.

Let me express one final hope and that is with reference to Recommendation 27, that I think it is excellent that the Conferees will reconvene at least annually. I hope when we reconvene that the ground rules will permit a vote by the Conferees at a progress meeting.

(Laughter.)

MR. STEIN: I am with you. You know, I hope your schedule will permit you to stay for the full session of the progress meeting.

(Laughter.)

DR. BORUFF: Mr. Chairman.

MR. KLASSEN: If I know where it is going to meet, I will be there.

(Laughter.)

MR. KLASSEN: I am not accustomed to meeting on buses, frankly.

And I might say, since you raised the point, that only one Conferee was there the next day, and I don't see how you could get a consensus of the Conferees, because the only Conferee there was the Federal Conferee. Mr. Egan, Mr. Poole and myself were not at the second day meeting.

MR. STEIN: Mr. Egan communicated with us. We were in Chicago. You know, Chicago is a big city and I am a big city boy and I know how to use the telephone and so does Mr. Egan. I never thought a bus was too bad and I always thought U. S. Steel was still United States territory and we could do business there.

MR. KLASSEN: This is true. But this vote was not taken at a regular session.

MR. STEIN: No vote was taken, sir.

DR. BORUFF: Mr. Chairman.

MR. STEIN: Yes.

DR. BORUFF: May I get the train on another track?

As a member of the Illinois State Sanitary Water Board, speaking as only one member, I would prefer that Mr. Klassen take these recommendations, not only of the Federal Conferee but the other Conferees, back to the Board and have time to discuss them, then Mr. Klassen to come back to a meeting of the Conferees for your final deliberation.

MR. STEIN: May we call on Indiana?

Mr. Poole?

MR. POOLE: Well, we certainly endorse Dr. Boruff's suggestion. That is, I haven't had a chance to digest the recommendations that have been made by the various States. I work for a Board, and while I have one Board member here, I would like to do the same thing Dr. Boruff suggests.

MR. STEIN: Michigan, Mr. Vogt?

MR. VOGT: I firmly believe that any final conclusions should be deferred at this time. I am also a member of a Commission and our next Commission meeting is on February 21 and 22. And I think it would be very important for me and for Mr. Oeming, who was the Michigan Conferee for the first four days, to discuss these points with our Commission, because whatever Michigan agrees to as a Conferee, it is extremely important that our statutes and our Commission policy will be able to implement the decision.

MR. STEIN: Mr. Holmer?

MR. HOLMER: As an evidence of Wisconsin's desire to move this forward, I will meet with my Board on Friday, but that was set sometime ago. But certainly, reporting to a Board, we will want to discuss these matters with them and we will be glad to reconvene at your convenience.

MR. STEIN: Mr. Poston?

MR. POSTON: Mr. Chairman, it appears that I should concede here, because everybody-- and I am very anxious to be cooperative and I will do this--concede that we should wait until others have had full opportunity to review all of these recommendations and to discuss them with their Boards. We stand ready and willing to provide any other information that they may want or definition of recommendations we have made. I think that there have been a great number of things that have been conceded here as fact and I think there is a lot of agreement amongst the Conferees as to what our problem is and how to come to these solutions.

MR. STEIN: Thank you.

Mr. Poston, you have been associating with Mr. Klassen and myself too long. You can no longer concede except by using a few thousand well chosen words.

(Laughter.)

In view of the State commitments and

the commitments of the Federal Government, I would like to suggest a date certain for getting back. I know you are going to have these board meetings. I don't want to make this too soon because I think we have to make haste slowly here. As I pointed out, we had better get a program that is going to work and that we can agree on and not start off with a program that isn't really thought through and we are not in concert with. I think the States and the Federal Government are relatively close together. This is very complicated and we need to come here to do it.

I am going to suggest March 7th in Chicago.

MR. KLASSEN: What day is that?

MR. STEIN: That is a Thursday.

MR. KLASSEN: That will be O. K. with me.

MR. STEIN: Is that clear?

Now, we will announce the date and place later. That March 7th meeting will be an executive session. That does not mean, gentlemen, that this will be a closed session. Executive session to us means that only the Conferees will talk and discuss and we will try to hammer out

Conclusions and Recommendations. The press and others are invited to be in. We probably will be facing each other at a table and you may not have the audience accommodations there, but we do our business in public. You are entitled to know what we do. You are entitled and everyone is, to know who is making which move, because I think that is the only way we can get pollution cleaned up.

One more thing. We have a statement for the record presented by Mrs. Robert G. Erickson of Racine, Wisconsin, who just couldn't arrive today, and without objection we would like to put that in the record at the conclusion of the statements of the people from Wisconsin as if read.

WISCONSIN PRESENTATION (CONTINUED.)

MR. HOLMER: There are three statements, Mr. Chairman, one a personal statement by Mrs. Erickson and one on behalf of the John Muir Chapter of the Sierra Club, and one by Mrs. Tom Helmbrecht, Homemaker. I would, of course, want those included.

PERSONAL STATEMENT OF MRS. ROBERT G. ERICKSON

MR. STEIN: They will all appear without objection as if read.

(Which said statements are as follows:)

PERSONAL STATEMENT-FOR THE CONFERENCE ON LAKE MICHIGAN POLLUTION FEBRUARY 7, 1968

Presented by Mrs. Robert G. Erickson

Closer to home I should like to comment on Green Bay pollution:

Governor Knowles merely called a Conference on this problem last year.

The outstanding statement of this meeting referred to pollution from the Fox River:

"It is as though the untreated waters from a city of a million people poured everyday from the Fox River into Green Bay." This does not refer so much to biological pollution but to chemical pollution and to almost complete lack of oxygen. It is no wonder that the end of Green Bay approaches Lake Erie's problems.

In addition Green Bay is one of the most heavily polluted water areas in regard to DDT.

PERSONAL STATEMENT OF MRS. ROBERT G. ERICKSON

Let us begin now to attack these problems; let us stop this out-pouring from the Fox River; Let us have all our municipalities clean up their sewage; Let us have all our industries clean up their waste matter; Let us have industry consider pollution control one of the expected and normal costs of doing business; Let us as consumers be willing to pay this cost; let us stop now the dumping into Green Bay of dredged sediments by the Army Corps of Engineers; Let us don off all other sources of pollutions; Let us stop the use of DDT and related compounds; Let us finally bring back Green Bay to what we can remember as children when in Door County one could see the bottom in 30 feet of sparkling blue water.

Will you help in this quest for clean water?

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STATEMENT FOR THE CONFERENCE
ON LAKE MICHIGAN POLLUTION
FEBRUARY 7, 1968
Presented by Mrs. Robert G. Erickson, Racine, Wis.

SIERRA CLUB, JOHN MUIR CHAPTER

The John Muir Chapter of the Sierra Club representing the State of Wisconsin urges immediate control of Lake Michigan pollution.

Next to the oxygen in the air we breathe, clean fresh water is man's most vital resource. 97 percent of the earth's supply of water is in the salty oceans still untapped for man's use. Over 2 percent of the earth's water is locked in ice - permafrost, ice caps, and glaciers. This leaves less than 1 percent of the earth's supply of water available for man. This water is in the form of lakes or streams or underground sources.

Our Great Lakes system is the largest surface supply of fresh water in the world. The quality of this supply is of the utmost importance to all of us.

The chapter deplores the fact that Lake Michigan has been used as a waste dumping ground. We urge the support of all local, State, and National officials, as well as all industries and individual citizens to cooperate fully in clearing up the Lake in the shortest possible time.

The chapter urges that a map of Lake Michigan be published, detailing all known sources of pollution so that citizens and conservation organizations as well as governmental agencies can bring these issues before the public.

Let us stop pollution before it is too late.

- - -

MRS. TOM HELMBRECHT
HOMEMAKER
MAYVILLE, WISCONSIN

Mrs. Tom Helmbrecht
704 Short Street
Mayville, Wisconsin
53050
22 January 1968

Mr. Stewart Lee Udall
Office of the Secretary
U.S. Department of the Interior
Washington, D.C. 20240

Dear Mr. Udall:

By invitation of the Wisconsin Department of Natural Resources, I submit the following statement to the chairman of the January, 1968 Conference on Lake Michigan pollution, being directly affected as a State and Federal taxpayer, resident of the State of Wisconsin:

That the job must be done is not an issue.

That it will be expensive is not an issue.

Two questions at issue appear to be: What methods will be used, and who will bear the expense?

Recently, there has been a tendency, at least in our state, to shift much of the responsibility for polluted waters to domestic type sewage by pointing an accusing finger at municipal sewage treatment plants. It should be recognized that when secondary municipal treatment plants are polluting, often they are being loaded beyond their capacity by industrial type wastes.

Taking statistics from the Wisconsin Blue Book of 1966 and from recent studies by the State Department of Natural Resources, the present total waste effluent from four of Wisconsin's leading paper mills is heavier in BOD than the waste produced by 1/6th of the State's population.

There were 188 paper mills, of various sizes, in the State ten years ago. The past ten years are known to have been record years for industrial growth here.

Now consider the waste from food and milk processing plants which is prohibitively high in BOD, according to State testing. Studies have shown that the Purity Cheese Company alone produces a waste equivalent in strength to five times the population of Mayville, the city in which it is located. There were 2,067 food and milk processing plants in the State of Wisconsin ten years ago.

These are statistics from the two types considered to be Wisconsin's leading industries. Ten years ago, there were 19 types of classified industries in Wisconsin, totalling 7,793 establishments. Some, of course, produce no more than domestic type waste, but such industries as those mentioned above, as well as the tanneries, chemical and power industries, must be considered highly responsible for the polluted condition of our waters.

It would therefore seem unfair to point

the finger at the residential polluter for financial purposes. He should, of course, bear his share of the expense. Perhaps, since the industries employ him and add to the State and National economy, he might even be asked to share some portion of industry's financial responsibility. But if industry is to be subsidized, let the fact be so stated. Note also that industry would be hard put to function without the working man, the group which pays most in taxes proportionate to the amount of his earnings. It would seem unfair should he be led to believe that he is personally responsible for the greater share of existing pollution.

I am not an expert in dynamics of pollution. Neither am I chemist, biologist nor trained engineer. The "how" of pollution abatement should be delegated to the experts.

I am an expert taxpayer by reason of experience. In this capacity, I ask that the States involved with the problems of pollution in Lake Michigan consider, as part of their strategy, exerting tighter controls over industries which utilize municipal sewage treatment plants for heavy industrial waste.

I request that industries contributing such waste to a municipal plant exercise controls necessary to prevent waste beyong reasonable standards from entering municipal systems. I suggest further that capital expenditure and support of maintenance should be provided by industries contributing a heavy waste load, in proportion to the part of any municipal system which is designed to treat their waste.

Respectfully, I submit this statement, and wish you success.

Very truly yours,

(Signed) Jan Helmbrecht

Homemaker

- - -

MR. STEIN: I think we have come a long way. I ask you all to keep the spotlight on us. I will ask the States and the Cities to do their homework so we can come back with meaningful Recommendations and Conclusions and hope to get an action program which yet will save Lake Michigan.

With that, we stand recessed until

March 7th in Chicago at a place to be announced, probably 9:30 in the morning.

(Whereupon, at 2:30 p.m., the Conference was adjourned until March 7th, 1968.

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(The following material was submitted after the close of the Conference:)

ILLINOIS PRESENTATION (CONTINUED)

- - -

BALTIS BUILT HOMES, INC.   10529 CERMAK RD.
562-2230   WESTCHESTER, ILL. 60153

March 1, 1968

Mr. Clarence W. Klassen
Illinois Conferee
Four-State Lake Michigan Conference
Chicago, Illinois

Dear Sir:

My name is Walter S. Baltis. I am a former Trustee of the Metropolitan Sanitary District of Greater Chicagoland; Chairman of its Engineering, Drainage and Stream Pollution

Committee until December 2, 1964.

Since 1964, I have charged in formal meetings of the Sanitary District, that they are deliberately and willfully emptying extremely high and dangerous levels of pollution into the Chicago River.

The extreme pollution is at the outfall of the Racine Avenue Pumping Station, which is a combined storm and sanitary pumping station with a capacity of 12,000 C.F.S., handling the total storm and sewage load of a 30-square-mile area in Chicago, having a population of 700,000, including industry.

The total sewage load, by a policy set in 1957, provided that at least 1 pump be in operation continuously to pump raw sewage as it developed to the Stickney plant for treatment. This policy was strictly adhered to until 1964. Since that time, up to 20 billion gallons of raw sewage yearly deliberately and willfully were dumped into the Chicago River by shutting off the pumps at Racine Avenue Pumping Station, thereby stopping the flow of sewage to the treatment plant. In other words, the plant could have very easily handled the treatment of the 20 billion gallons of sewage that was deliberately and willfully stored in the sewers and interceptors then dumped into the Chicago River during the slightest rainfall.

The 20 billion gallons of sewage yearly is equivalent to the total daily sewage load of a city of 228,000 population, including industry. This means that over 20,000 tons yearly of undigested sewage that should have been processed causes extreme pollution and creates an additional health hazard by depleting the reservoir capacity of the Chicago River, and adding to the extreme pollution of Lake Michigan whenever the flow of the Chicago River must be reversed, due to heavy rainfall in the Metropolitan Chicago area. Further, the U. S. Corps of Engineers has to do the extra dredging of the sludge for dumping into Lake Michigan to provide a passable navigation channel. Further, any reversal of the Chicago River and its branches to Lake Michigan must be eliminated at once, as the potential health hazard and well-being of the people of the Metropolitan Chicago area are in this instant in complete jeopardy whenever the flow of the Chicago River must be reversed and thereby causing extreme pollution of Lake Michigan.

(Signed) Walter S. Baltis

Walter S. Baltis
10529 W. Cermak Road
Westchester, Illinois 60153

Phone--562-2230

WSB/jn

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February 5, 1968

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WILLIAM A. RIASKI

Mr. Murray Stein, Chief Enforcement Officer
Federal Water Pollution Control Administration
633 Indiana Avenue, N.W.
Washington, D. C. 20242

Dear Mr. Stein:

Enclosed you will find copies of the League's statement which I was scheduled to deliver on Friday, February 2, at the Four State Conference on Lake Michigan Pollution in Chicago.

Shortly before the time I was to give the statement, Mr. Clarence W. Klassen, Chief Sanitary Engineer, Illinois Sanitary Water Board, broke into a conversation I was conducting with a representative of U. S. Senator Gaylord Nelson to say: "Riaski, I will not allow you to make that statement here today. It is not pertinent to this conference".

I felt the statement was "very pertinent" to the subject of the conference and this was reinforced a few moments later by remarks made by William Clark, Attorney General, State of Illinois, in which he lamented that after forty years of frenetic effort on the part of the Illinois Sanitary Water Board, there was not a single stream in the State which could be labeled "safe for swimming or water skiing."

Had the shining deeds of accomplishment of the four State pollution abatement agencies represented been of consequence worthy of consideration, I am positive any words of contradiction on the part of the League would most certainly have been greatly overshadowed in the minds of those present at the conference. Unfortunately for the four agencies, they were not allowed to have this comparison made; hence they were denied the plaudits which they most certainly feel they deserve!!!

As I have therefore been denied my right of free speech, I therefore request the attached statement and this letter be entered into the printed record so interested persons and organizations which have a real and active interest in clean water for America will at least have an opportunity to read it.

Mr. Stein, for the past forty-five years there has been entirely too much "lip service" devoted to prattle about "clean water" while during the same period there has been far too little real effort devoted to this cause by many of the State agencies whose duties at least implied their responsibility for action in this field.

I would appreciate receiving, as soon as possible, the list of those folks and the organizations they represented who registered as being in attendance.

With best wishes, I am

Conservationally yours,

(Signed) William A. Riaski

William A. Riaski
Executive Director

WAR;cha

encls.

CC: Joe G. Moore, Jr., Commissioner, FWPCA
Charles M. Rogers, Chief Info. Officer, FWPCA
Clarence W. Klassen, Chief Sanitary Engineer, Illinois Sanitary Water Board
Blucher A. Poole, Technical Secy., Indiana Stream Pollution Control Board
Loring F. Oeming, Exec. Secy., Michigan Water Resources Commission
Freeman Holmer, Director, Wisconsin Department of Resource Development
Joseph W. Penfold, Conservation Director, IWLA

encl.

STATEMENT OF
THE IZAAK WALTON LEAGUE OF AMERICA
AT THE
FOUR STATE CONFERENCE ON
POLLUTION OF LAKE MICHIGAN

Bal Tabarin Room
Sherman House
Chicago, Illinois
February 2,1968

Mr. Chairman: I am William A. Riaski, Executive Director of The Izaak Walton League of America, the National Headquarters of which is located in Glenview, Illinois. The League is a 46 year old nation-wide organization of citizens dedicated to the wise and proper use of America's natural resources.

It may be of some interest to you to know that the League, at the behest of President Hoover, in 1927 conducted the first nation-wide survey of water pollution in the United States. Mr. Hoover at the time was Secretary of Commerce and the Honorary President of the League. The League was then but five years old but throughout its life it has had an active and intense interest in water pollution abatement.

In 1927, there was no Federal agency specifically charged with abating water pollution. The Illinois Sanitary Water Board came into existence shortly thereafter due to the activities of the Illinois State Division of the League. Various other State Divisions of the League were likewise active in this connection and similar pollution abatement agencies resulted in many states. All supposedly were created to abate water pollution but with a few exceptions, the records of these State agencies were most notable for their mediocrity between 1927 and 1962. The period between 1962 and 1968 has yet to reveal much more in the way of actual accomplishment though it has been noted some have finally indicated considerable interest in the job they were supposed to have been doing for, lo, these many years.

At the time this statement was being composed ten days ago, the proposed water quality standards submitted by Illinois and Michigan to the Federal Water Pollution Control Administration had not been approved by it. I am rather positive this was not due to the fact the proposals submitted by these States were unrealistically high!!! Each of these States borders on Lake Michigan and, in addition, some watershed in each drain into the Lake.

On March 3, 1965, I attended an Illinois-Indiana Interstate Water Pollution Conference at McCormick Place in Chicago. It, too, dealt with Lake Michigan. Unfortunately, McCormick Place has since been destroyed by a disastrous fire. I have often wished as hot a fire could have been built under the State Water Pollution agencies represented here today. Had this been the case, I'm certain it would have gotten them off their "fannies" and into action, and might have resulted in enough solid progress in abating water pollution, so there would have been little need for this particular conference.

The Federal Water Pollution Control Administration is a rather new organization though amongst its ranks it does number quite a group of folks who have had considerable previous experience in the field of water pollution abatement.

m-o-r-e

I shall reserve my judgment as to the merits of the organization for a few more years for I most certainly realize the lethargy which it has encountered at the State level.

I do want to mention one particularly bright spot in the water pollution abatement picture. It happens to be a local development but, insofar as actual accomplishment is concerned, I have yet to hear of anything in this country which will begin to match it.

Mr. Vinton W. Bacon, the General Superintendent of the Metropolitan Sanitary District of Greater Chicago, has motivated his organization into not only instituting a wide variety of pilot projects aimed to reduce pollution but some have demonstrated real worth. His plans envisage applying these results on a broad scale and some are in the construction stage already.

In addition, he has instituted court action against major polluters not only in Illinois but in Indiana as well.

The water quality standards established under Mr. Bacon's direction in Cook County far exceed those established by the Illinois Sanitary Water Board. Furthermore, he has taken forceful steps to implement the Sanitary District's standards.

The Izaak Walton League of America does not intend to let Mr. Bacon's excellent work go unrecognized. The League is presenting to him its highest award for his resolute action in not only clearly and loudly warning of the great dangers inherent in water pollution but, far more importantly, doing something constructive to abate water pollution.

During this conference this room has been filled with folks who, because of their professional training, skills and experience, are well prepared to take effective action to reduce water pollution.

For the forty-six years of the League's existence, this has often been true at other meetings in regard to water pollution.

In the past, the ingredient which has been sadly lacking was the necessary motivation to put these trained people in a position where their abilities and skills could be effectively applied in a manner which would produce the needed results.

Everywhere the citizens of the United States are now demanding action in abating water pollution. The Izaak Walton League of America has been most gratified to note the steadily increasing number of individuals and organizations which have cooperated with it in working for Clean Water. I am certain this has proven to be both time consuming and costly for them just as it has for the League. The only reward most of them will receive will be their own self satisfaction if they are successful in their mission.

However, each and everyone of them certainly deserves the League's commendation for their high minded and spirited interest in not only their own families but in everyone in the United States regardless of race, creed or political belief. Clean Water is a universal benefit and it is likewise extremely important to the continued success and growth of this Nation.

m-o-r-e

Frankly, the League is well pleased with the recommendations made to this conference by the Federal Water Pollution Control Administration. No doubt I could make some specific suggestions as to how some of its recommendations might perhaps be strengthened and how some others could be added to its list.

Uncounted billions of words have been written and spoken about Clean Water in the past 46 years. The needed ingredient is "action" and not more words regardless of how sincere they might be. Therefore, I shall not try to add to your recommendations further details for, in essence, the League will measure not just the intent of the words of which the recommendations are constructed, but rather the goals which are achieved.

The Izaak Walton League of America is of the opinion it is high time firm and positive steps are taken to produce Clean Water for America.

Many times you have told us you know how to do it!!! Alright, let's get the job done and not waste more time talking about the best way to do it.

The Izaak Walton League of America is honored to have been able to present its views and it calls upon each and every one of you to take immediate steps to produce Clean Water for America.

William A. Riaski
Executive Director
The Izaak Walton League of America
1326 Waukegan Road
Glenview, Illinois 60025

STATE OF ILLINOIS
SANITARY WATER BOARD
SPRINGFIELD

THE BOARD

FRANKLIN D. YODER, M.D.,M.P.H.,
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Technical Secretary
Clarence W. Klassen
Chief Sanitary Engineer
Department of Public Health

Address Letters to:
State Sanitary Water Board
Springfield, Illinois
62706

February 9, 1968

LAKE MICHIGAN - Four State Conference
January 31, 1968 - Chicago

Mr. William A. Riaski
Executive Director
The Izaak Walton League of America
National Office
1326 Waukegan Road
Glenview, Illinois 60025

Dear Mr. Riaski:

I received a copy of your February 5

letter to Mr. Stein relative to the League's statement which you prepared for the Four State Conference on Lake Michigan pollution meeting in Chicago, when I returned to Springfield on February 8th following the conference.

I want to be on record concerning this letter and your statement. Three of the prepared statements were not pertinent to the subject before this conference, namely Lake Michigan, and therefore I did indicate to you that because of this fact I could not sponsor this statement on Illinois time. I personally feel it is extremely unfortunate that such a fine organization as the Izaak Walton League of America did not prepare a productive statement which could be a positive instrument to accelerate the cleanup of Lake Michigan. To substantiate this feeling, I would like to suggest that the League prepare such a statement and I will submit it to the Chairman and request that it be included in the record. I feel that the Izaak Walton League should be on record in the conference. I am referring to the National Izaak Walton League, inasmuch as for all of the four States, including

Illinois, the particular State division did present excellent statements.

May I also suggest that if you desire to include any criticism of the Sanitary Water Board please feel perfectly free to do so. I want to emphasize this point because of the information apparently that you had given Senator Nelson that your statement was excluded by me because it was critical of the Illinois Board. This is positively not the case.

I am hopeful however that all of the statements critical or otherwise will be based on correct facts. In this connection, I would like to call your attention to two items in your original prepared statement that are not in this category.

The first of these examples is the second sentence in the third paragraph on page 1, "The Illinois Sanitary Water Board came into existence shortly thereafter due to the activities of the Illinois State Division of the League." This is not a correct statement. The original Sanitary Water Board law enacted in 1929 was prepared by my predecessor, the late Harry F.

Fergeson with the assistance of the late Anna W. Ickes, who was then a member of the Legislature and who introduced and sponsored this legislation. I was Mr. Fergeson's assistant at that time and I am intimately acquainted with all of the details of this legislation. The present Sanitary Water Board law under which we operate was enacted in 1951 and this was the result of a legislative commission and was not the result of any activity of the Izaak Walton League. At the signing of this piece of legislation, Governor Stevenson invited any persons interested in this legislation to be present. This was and still is a policy of the Governor. The then chairman of the State Division of the League was invited, was present, was in the picture taken during the signing and this has often been interpreted by the League as proof of activity in sponsoring this legislation. I was present at the signing. Then like now the Governor in signing used many different pens and passed these out as souvenirs to all of those present. I believe I am correct that the then chairman of the League had this framed as further proof that this was the pen that signed the Sanitary

Water Board law and was in possession of the League. I also had one of these pens.

Another incorrect statement is the fifth paragraph on page two which reads, "The water quality standards established under Mr. Bacon's direction in Cook County far exceed those established by the Illinois Sanitary Water Board. Furthermore, he has taken forceful steps to implement the Sanitary District's standards."

I am assuming that you are implying standards in Cook County established by the Metropolitan Sanitary District. This is not correct. The Metropolitan Sanitary District has not established any water quality standards even though they were required by a recent Act of the Legislature to do so. The Sanitary District trustees have by official resolution taken action to enforce the water quality standards established by the Sanitary Water Board. This action was taken several months ago and since that time the Illinois Sanitary Water Board standards applying to Chicago Metropolitan Sanitary District have been approved by Secretary Udall. I am sure you are aware that all of Cook County is not under the jurisdiction of the Metropolitan Sanitary District. In that portion of Cook County namely, in the Chicago Heights-Lansing area that is not under the jurisdiction of the Chicago Sanitary District, all municipal sewage is receiving complete treatment and disinfection and a number of the plants already have tertiary treatment. The industries that are not already complying with the new criteria are under order by the Sanitary Water Board to accomplish this by December 1968. Therefore, your statement that the water quality standards established in Cook County far exceed those established by the Illinois Sanitary Water Board is not a correct statement for reasons given above.

I again want to urge you to prepare a statement on behalf of the National Izaak Walton League that pertains to the cleanup of Lake Michigan so that this can be included into the record of this conference. A copy of this letter is also being sent to Senator Nelson because of his statement made on the Senate floor, February 5th, which indicated that a statement by the Izaak Walton League had not been permitted to be included in the record because of its criticism of the State Water Pollution Control agency.

Sincerely,

(Signed) C. W. Klassen

C. W. Klassen
Technical Secretary

CSK:mh

cc - Murray Stein
Senator Nelson
Joe Chantigney
Joe G. Moore, Jr., Commissioner, FWPCA
Charles M. Rogers, Chief Info. Officer, FWPCA
Blucher A. Poole, Tech. Secy., Indiana Stream Pollution Control Board
Loring F. Oeming, Exec. Secy., Michigan Water Resources Commission
Freeman Holmer, Director, Wisconsin Department of Resource Development
Joseph W. Penfold, Conservation Director IWLA
SWB Chicago

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